** Preliminary Submittal **

Northfield Township, Michigan

NORTHFIELD TOWNSHIP SANITARY SEWER STUDY

Prepared by

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November 2003

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EXECUTIVE SUMMARY

This report has been prepared on behalf of Northfield Township to identify and develop sanitary sewer infrastructure alternatives to serve future developments in the Whitmore Lake, North Territorial Road, and Northfield Church Road vicinities.

The study area consists of approximately 2,760-acres of land that have the potential to be developed for commercial, industrial, and residential uses. The land within the proposed study area is primarily vacant in the North Territorial and Northfield Church Road vicinities, with existing commercial and residential developments located predominantly in the Whitmore Lake vicinity. The estimated average day sewage flow from the Whitmore Lake and North Territorial vicinities is approximately 680,000 gallons per day, while the sewage flow from the Northfield Church Road vicinity is approximately 1,160,000 gallons per day. For projected growth rates in Northfield Township, sewage flow from the Northfield Church Road vicinity is not anticipated in the next twenty years.

Service districts have been identified to provide transport of sanitary sewage from the Whitmore Lake and North Territorial vicinities. The specific service districts and conceptual opinions of probable project cost are presented below.

Service District Opinions of Probable Project Cost	
Service District	**Conceptual Opinion of Probable Project Cost**
1	$860,000
2	$780,000
3 – Option C	$2,320,000
4	$350,000
5	$1,180,000
6	$530,000
7	$840,000
8 Mile PS Upgrade	$600,000
N. Territorial PS Upgrade	$2,950,000
Totals	**$10,410,000**

Detailed opinions of probable project cost for the Whitmore Lake vicinity Service Districts 1 through 4 and Eight Mile Pump Station Upgrade are located in Appendix A. Detailed opinions of probable project cost for the North Territorial vicinity Service Districts Zones 5 through 7 and North Territorial Pump Station Upgrade are located in Appendix B.

It is recommended that Northfield Township pursue improvements to the sanitary sewer system that encompass both expansion of new infrastructure and increasing capacity of existing infrastructure as new development is identified in the Whitmore Lake and North Territorial vicinities. Due to the uncertainty regarding location and timing of new development in the Whitmore Lake and North Territorial vicinities, it is also recommended infrastructure improvements be over-sized to minimize the potential of future sewage flow exceeding the capacity of these infrastructure improvements.

The sanitary sewage from the study area will be directed to the existing Northfield Township Wastewater Treatment Plant (WWTP). Inclusion of the study area into the existing sanitary sewer system will require expansion of the existing WWTP.

INTRODUCTION

This sanitary sewer study has been prepared on behalf of Northfield Township to evaluate alternatives to provide sanitary sewer service to areas in the vicinity of Whitmore Lake and North Territorial Road. The land within the proposed expanded service areas is primarily zoned Agriculture, but there is indication that development of these areas for residential, commercial, and limited industrial development is likely. This sanitary sewer study evaluates alternatives for providing sanitary sewer service for the anticipated development, including improvements to existing sanitary infrastructure for transport to the Northfield Wastewater Treatment Plant (WWTP).

EXISTING SERVICE AREAS

Whitmore Lake Vicinity

The existing sanitary sewer infrastructure in this vicinity extends around the entire perimeter of Whitmore Lake, accepting sanitary flow from predominantly residential neighborhoods in both Northfield and Green Oak Townships. Sanitary flow is collected and transported by gravity sewer and periodically by pump stations, with the primary transmission sewers located along Main Street and East Shore Drive. Additionally, sanitary sewer extends south along Whitmore Lake Road from East Shore Drive to Six Mile Road, servicing a mixture of commercial and residential properties. Flows from around Whitmore Lake and Whitmore Lake Road are combined and transported west underneath US-23. These combined flows, as well as additional residential sanitary sewer flow from Barker Road, are directed to the 8 Mile Pump Station. Sewage flow from the Eight Mile Pump Station is transported via a force main and discharges at the Northfield WWTP. A map of the Whitmore Lake Vicinity sanitary sewer system is shown in *Figure 1*.

The original transmission sewer mains along East Shore Drive, Main Street, and Whitmore Lake Road to the Eight Mile Pump Station were constructed in the late 1960's

and consist of 12, 15, and 18-inch pipe installed at minimum grades. With the resulting development in the past several decades since their installation, the peak flows in sections of these sewer pipes have been measured and have been found to be near the maximum pipe capacities during large rain events due to inflow and infiltration. It is expected that the gravity sewer capacity between the East Shore Drive and Main Street intersection and the Eight Mile Pump Station will be exceeded during the 25-year or greater rain event with the onset of additional development. Anticipated peak sewage flows during the 25-year rain event and corresponding pipe capacities are shown in *Figure 2*.

The East Shore Pump Station 1, located on East Shore Drive between Main Street and Seven Mile Road, accepts flow from the north and eastern extents of Whitmore Lake. This pump station is designed with a firm pumping capacity of 450-gpm and is nearing the limits of its design capacity. The Washtenaw County Road Commission (WCRC) has indicated that they will require the relocation of this pump station away from its current location should the pump station be upgraded or otherwise modified. There is the potential that the WCRC may require the pump station to be moved even if no improvements are performed if they undertake roadway improvements.

The Eight Mile Pump Station was reconditioned and upgraded in 2000 to a firm pumping capacity of 3,300-gpm. Currently, this pump station accepts flow from the Whitmore Lake vicinity as well as flow from the North Territorial vicinity via the North Territorial Pump Station. During peak flow conditions, the Eight Mile Pump Station is at approximately two-thirds its firm pumping capacity. Flow from the Eight Mile Pump Station enters a 12-inch force main and travels approximately 3,000 linear feet to the Northfield WWTP. There is also a parallel existing 8-inch force main from the pump station to the WWTP that was taken out of service approximately twelve years ago. There is the potential that this 8-inch force main has deteriorated from disuse to a point where it is no longer suitable for sanitary sewer service in the future.

North Territorial Vicinity

The existing sewage flow in this vicinity extends along North Territorial Road from Whitmore Lake Road to the Ann Arbor Rail Road, just west of Nollar Road. This infrastructure was installed in 2000 and consists of 8, 12, 15, and 21-inch gravity sewer as well as the North Territorial Pump Station. Flow from the North Territorial Pump Station is directed along approximately 21,000 linear feet of 12-inch force main to the Eight Mile Pump Station. A map of the North Territorial Vicinity sanitary sewer system and the current service districts is shown in *Figure 3*.

The gravity sewer along North Territorial Road and the pump station were designed to accommodate the anticipated commercial and light industrial development within the special assessment district. Currently, this system experiences little demand, as major development in this area has not commenced as anticipated.

The North Territorial Pump Station was originally designed with an ultimate firm pumping capacity of 1,400-gpm through a pair of parallel 12-inch force mains. Currently, the firm pumping capacity of the station is set at 700-gpm through a single force main. When further capacity is required, the pump station is ready to be installed with an additional pump, which will upgrade the firm pumping capacity to the ultimate 1,400-gpm. As originally planned, the increase in firm pumping capacity to 1,400-gpm will require the installation of a second 12-inch force main to the Eight Mile Pump Station. Attempting to transport 1,400-gpm through the single 12-inch force main will generate total dynamic head in excess of the pumps' ability to generate flow.

Northfield Wastewater Treatment Plant

The existing sanitary sewer flow from the Eight Mile Pump Station discharges directly to the Northfield WWTP via a 12-inch force main. The Northfield WWTP currently processes an average daily flow of approximately 800,000 gallons per day, with the capacity to process an average daily flow of 1,300,000 gallons per day. The Phase I special assessment district (SAD) for the North Territorial sanitary sewer improvements

constructed in 2000 encompasses land expected to generate an average daily flow of approximately 390,000 gallons (1500 REU) per day. Combining the existing WWTP flow with the expected flow from the North Territorial Phase I (SAD), as well as an average daily flow of approximately 39,000 gallons (120 REU) per day currently allocated to Green Oak for Whitmore Lake vicinity development, there is approximately 71,000 gallons (270 REU) of average day flow capacity remaining. The construction of the Whitmore Lake High School, expected to require 120 REU, will further reduce the available capacity at the WWTP to approximately 150 REU. Any development beyond this limited capacity will require expansion of the WWTP.

PROJECTED DEVELOPMENT AREAS

The study area includes approximately 2,760-acres of land that have the potential to require public sanitary sewer service. These areas are currently zoned *Agriculture*, and in the future they are likely to experience residential, commercial, and light industrial development growth.

Whitmore Lake Vicinity

Four new development areas have been identified by Northfield Township that would connect to the existing sanitary sewer infrastructure around Whitmore Lake. The areas and Northfield Township's expectations for future zoning are shown in *Figure 4* and are described as follows.

- **Wildwood Lake Area** – Approximately 258-acres of land between Kearney and Jennings Roads, south of Wildwood Lake. This area has the potential to be rezoned *Single Family Residential 1*, with a maximum density of 4 residences per acre.

- **Seven Mile Area** – Approximately 234-acres of land along 7 Mile Road between East Shore Drive and Donna Lane. This area has the potential to be rezoned *Single Family Residential 1*, with a maximum density of 4 residences per acre.

- **Kelly Area** – Approximately 282-acres of land south of the Eagle Gardens development, east of Whitmore Lake Road. This area has the potential to be rezoned *Single Family Residential 1*, with a maximum density of 4 residences per acre. This land is not expected to develop within the next twenty years.

- **Whitmore Lake High School Area** – Approximately 82-acres of land on Whitmore Lake Road, between Five Mile and Six Mile Roads. This area is being developed for the proposed Whitmore Lake High School, which is expected to accommodate 1,200 students.

North Territorial Vicinity

Seven new development areas have been identified by Northfield Township that will connect to the existing sanitary sewer infrastructure along North Territorial Road. The areas and Northfield Township's expectations for future zoning are shown in *Figure 5* and are described as follows.

- **Six Mile Commercial Area** – Approximately 13-acres of land on Six Mile Road, east of Whitmore Lake Road on either side of US-23. This area has the potential to be rezoned *Highway Commercial.*

- **US-23 Service Road Commercial Area** – Approximately 26-acres of land north of an existing service road east of US-23, between North Territorial and Five Mile Roads. This area has the potential to be rezoned *General Commercial.*

- **US-23 Service Road Residential Area** – Approximately 17-acres of land north of an existing service road east of US-23, between North Territorial and Five Mile Roads. This area has the potential to be rezoned *Multiple Family Residential*, with a maximum density of five residences per acre.

- **Grand Sakwa Phase I Area** – Approximately 212-acres of land west of Whitmore Lake Road between Five Mile and North Territorial Roads. This area has the potential to be rezoned *Single Family Residential 1*, with approximately 470 residences expected within the development.

- **Whitmore Lake Road Commercial Area** – Approximately 225-acres of land east of Whitmore Lake Road, between Five Mile and North Territorial Roads. This area is currently zoned *General Commercial.*

- **Nollar Road Commercial Area** – Approximately 58-acres of land west of the Nollar and North Territorial Road intersection. This area is currently zoned *General Industrial.*

- **Nollar Road Residential Area** – Approximately 9-acres of land on Nollar Road, south of the intersection with North Territorial Road. This area is currently zoned and expected to remain *Low Density Residential*, with a maximum density of one residence per acre.

Northfield Church Road Vicinity

Five new development areas have been identified by Northfield Township that will connect to the existing sanitary sewer infrastructure along North Territorial Road. Assuming an average growth rate of two percent (2%) for the Township, it is not likely that these areas will experience development levels in the next twenty years sufficient to support the construction costs of extending sanitary sewer service. The areas and Northfield Township's expectations for future zoning are shown in *Figure 5* and are described as follows.

- **Whitmore Lake Road Industrial Area** – Approximately 26-acres of land on the east side of Whitmore Lake Road, between North Territorial and Joy Roads. This area has the potential to be rezoned *Limited Industrial.*

- **Whitmore Lake Road Residential Area** – Approximately 3,530-acres of land west of Whitmore Lake Road between North Territorial and Northfield Church Roads. This area has the potential to be rezoned a mixture of *Single Family Residential 1, Single Family Residential 2,* and *Multiple Family Residential.*

- **Northfield Church RTM-A Area** – Approximately 360-acres of land east of US-23, between North Territorial and Northfield Church Roads. This area has the potential to be rezoned *Research, Manufacturing and Technology.*

- **Northfield Church RTM-B Area** – Approximately 145-acres of land west of Nollar Road and north of Northfield Church Road. This area has the potential to be rezoned *Research, Manufacturing and Technology.*

- **Northfield Church RTM-C Area** – Approximately 616-acres of land east of US-23 and south of Northfield Church Road. This area has the potential to be rezoned *Research, Manufacturing and Technology.*

PROJECTED WASTEWATER FLOWS

Resident Equivalent Units (REUs) were used to equate sanitary flow from commercial and industrial users to residential users. An REU represents a typical single family residential home. The average sewage flow for each REU is 260 gallons per day average. The 260 gallons per day is based on 100 gallons per day per person and 2.6 persons per household. The maximum day flow is typically estimated to be twice the average day flow, and the peak hour demand is determined per the *Ten States Standards*, which for this study has been calculated at three and one-half times the average day flow. The design flows used in this study are as follows.

Average Day Demand = 100 gpd per person x 2.6 people per household = 260 gpd / REU
Maximum Day Demand = Average Demand x 2 = 520 gpd / REU
Peak Hour Demand = Average Day Demand x 3.5 = 910 gpd / REU

Additionally, Northfield Township has several zoning classifications within the Existing and Projected Development Areas. Each zoning district has a maximum allowable development density that corresponds to an average number of REUs per acre. The assumed development densities used in this study are presented in Table 1.

Table 1 - Development Densities		
Zoning Classification	**Abbreviation**	**REU / Acre**
Single Family Residential 1	SFR1	4.0
Single Family Residential 2	SFR2	5.8
Low Density Residential	LR	1.0
Multiple Family Residential	MR	5.0
General Commercial District	GC	2.5
Highway Commercial District	GI	2.5
Limited Industrial District	HC	2.5
Planned Shopping Center	LI	2.5
Research / Technology / Manufacturing	RTM	2.5

The development density of 2.5 REU per acre for commercial, industrial, and RTM zoning is based on current development trends in neighboring townships.

In determining REUs for large single-family zoned residential projects, it is assumed that twenty-five percent (25%) of the total acreage available will be utilized for roads, easements, and storm water runoff areas, leaving seventy-five percent (75%). However, or the purposes of this study, an additional factor of seventy percent (70%) has been applied as the maximum allowable development density for the remaining acreage in the residential zoned projects. This percentage has been applied to account for portions of the land in the study area that cannot be built upon due to poor soil conditions, wetlands, or other land constraints. Computation of REUs on a typical 20-acre single-family residential zoned parcel is shown below.

Example

Maximum Development Density = 20-acres x 2 REU / acre x 75% x 70% = 21 REU

For commercial, industrial, and multiple-family zoned parcels, only the seventy percent (70%) factor has been applied as the maximum allowable development density for the total acreage of the parcel. As with the single-family parcels, this percentage has been applied to account for portions of land in the study area that cannot be built upon. Computation of REUs on a typical 20-acre commercial zoned parcel is shown below.

Example

Maximum Development Density = 20-acres x 2.5 REU / acre x 70% = 35 REU

Using the development densities in Table 1 and the seventy percent development assumption, the number of REUs and designed wastewater flows in the projected development areas are presented in Table 2.

Table 2

REU Projection & Design Wastewater Flows

Development Area	Total Acres	REU Projection	Average Day Demand (gallons)	Max Day Demand (gallons)	Peak Hour Demand (gallons)
Wildwood Lake	258	540	140,000	280,000	491,000
Seven Mile	234	490	127,000	254,000	446,000
Kelly	282	600	156,000	312,000	546,000
High School	82	120	31,000	62,000	109,000
Six Mile Commercial	13	30	8,000	16,000	27,000
US-23 Service Rd Commercial	26	50	13,000	26,000	46,000
US-23 Service Rd Residential	17	50	13,000	26,000	46,000
Grand Sakwa Ph I	212	470	122,000	244,000	428,000
Whitmore Lake Rd Commercial	71	130	34,000	68,000	118,000
Nollar Road Commercial	58	110	29,000	58,000	100,000
Nollar Road Residential	9	10	3,000	6,000	9,000
Whitmore Lake Rd Industrial	610	2450	637,000	1,274,000	2,230,000
Whitmore Lake Rd Residential	26	50	13,000	26,000	46,000
Northfield Church RTM-A	360	630	164,000	328,000	573,000
Northfield Church RTM-B	145	260	68,000	136,000	237,000
Northfield Church RTM-C	616	1080	281,000	562,000	983,000
Totals	**2,761**	**7,070**	**1,839,000**	**3,678,000**	**6,435,000**

The values in Table 2 have been used to determine the size of new sanitary sewer improvements as well as upgrades of existing infrastructure. The infrastructure improvement requirements are discussed in the *Analysis of Alternatives*.

ANALYSIS OF ALTERNATIVES

The areas of potential sanitary sewer service within Northfield Township for the purpose of this study have been divided service districts within the Whitmore Lake and North Territorial vicinities. Within the Whitmore Lake vicinity, there are four service districts identified, which are the locations of the infrastructure improvements necessary to provide sanitary sewer service to the Wildwood, Seven Mile, and Whitmore Lake High School Development Areas. While sanitary sewer service is not shown extended to the Kelly Development Area, as the land is not expected to be developed in the next twenty years, sanitary sewer infrastructure improvements for the purpose of this study have been sized to accommodate sewage from this area should it become developable. The conceptual locations of new sanitary sewer transmission mains for the Whitmore Lake Vicinity are shown in *Figure 6.*

Within the North Territorial vicinity, there are also three service districts identified, which are the locations of the infrastructure improvements necessary to provide sanitary sewer service to the 6 Mile, US-23 Service Road Commercial and Residential, Grand Sakwa Phase I, Whitmore Lake Commercial, and Nollar Road Commercial and Residential Development Areas. The conceptual locations of new sanitary sewer transmission mains for the North Territorial vicinity are shown in *Figure 7.*

The Whitmore Lake Road Industrial, Whitmore Lake Residential, and Northfield Church Road RTM A, B, and C Development Areas that have been identified by the Township are in the Northfield Church Road vicinity and would discharge to existing sanitary sewer in the North Territorial SAD, but conceptual locations of new sanitary sewer transmission mains have not been provided as part of this study. At projected growth rates, these areas are not anticipated to experience development levels in the next twenty years sufficient to support the construction costs of extending sanitary sewer service.

Whitmore Lake Vicinity

The Wildwood Lake, Seven Mile, Kelly, and Whitmore Lake High School Development Areas are located within the Whitmore Lake vicinity and will require four service districts to accommodate development. The four districts represent approximately 885-acres of land and have the potential to generate 2,430 ultimate REUs if developed to maximum density. Though it is not anticipated that the Kelly Development Area will be developed in the next twenty years, gravity sewer infrastructure improvements have sized to accommodate future flows from this area. Detailed opinions of probable project cost for each service district are shown in Appendix C.

- **Service District 1** (*Figure 8*) – this area includes the replacing the existing 18-inch gravity sewer between Barker Road and the Eight Mile Pump Station with 24-inch pipe. The upgrade of this pipe is necessary to accommodate additional flow from the Wildwood Lake, Seven Mile, and Kelly Development Areas. The conceptual opinion of probable project cost for Service District 1 is $860,000.

- **Service District 2** (*Figure 9*) – this area includes constructing new 8-inch sanitary sewer lines along Jennings Roads to service the Wildwood Lake Development Area. The new pipe will connect to existing 8-inch and 10-inch sewer lines. Additionally, approximately 350-linear feet of existing 10-inch line on Barker Road will be replaced with 12-inch sewer. Routing a portion of the flow through the North Pointe Community's existing 8-inch sewer line reduces the overall project cost of providing sanitary sewer service and still accommodates the anticipated 540 REUs from the Wildwood Lake Development Area. The conceptual opinion of probable project cost for Service District 2 is $780,000.

- **Service District 3** – this area includes constructing new 8-inch sanitary sewer lines along 7 Mile Road to service the Seven Mile Development Area. Flow from the Kelly Development Area beyond twenty years will be routed through the existing Eagle Gardens development sanitary sewer, which will require upgrading the Eagle Gardens Pump Station at that time. Additional sewer capacity along East Shore Drive and Barker Road between US-23 and Seven Mile Road will also be required to accommodate the ultimate 1,210 REUs from the Seven Mile Development Area, the Kelly Development Area, and Green Oak Township. There are several options available to Northfield Township to upgrade the existing sanitary sewer routes along East Shore Drive and Barker Road.

  Option A (*Figure 10*) – replace existing 12-inch sewer along East Shore Drive with 15 and 18-inch pipe, and replace existing 18-inch sewer between the railroad and US-23 with 21-inch pipe. East Shore Pump Station #1 will be upgraded to an 850-gpm firm pumping capacity. The conceptual opinion of probable construction cost for this option is $4,290,000.

  Option B (*Figure 11*) – replace existing 12-inch sewer along East Shore Drive between Seven Mile Road and the East Shore Pump Station #1 with 15-inch pipe. East Shore Pump Station #1 will be upgraded to an 850-gpm firm pumping capacity. The pump station will discharge sewage through a new 8-inch force main that will be directionally drilled along East Shore Drive to Whitmore Lake Road. The force main will discharge to replacement 18 and 21-inch sewer. The existing 12-inch sewer along East Shore Drive between the East Shore Pump Station and Whitmore Lake Road will remain in place to provide continued service to existing customers. The conceptual opinion of probable construction cost for this option is $3,030,000.

Option C (*Figure 12*) – construct a new pump station with an 850-gpm firm pumping capacity to collect flow from the Seven Mile Development Area and Green Oak Township near the intersection of Seven Mile Road and East Shore Drive. A new 8-inch force main will be installed along East Shore Drive from Seven Mile Road to Whitmore Lake Road. The force main will discharge to replacement 18 and 21-inch sewer. The existing 12-inch sewer and East Shore Pump Station # 1 along East Shore Drive to Whitmore Lake Road will remain in place to provide continued service to existing customers. The conceptual opinion of probable construction cost for this option is $2,300,000.

- **Service District 4** (*Figure 13*) – this area includes constructing new 8-inch gravity sewer from the existing sewer line at the intersection of Coyle and 6 Mile Roads approximately 1,600 linear feet to the property of the proposed Whitmore Lake High School. The proposed high school is expected to have approximately 1,200 students and generate 120 REU. The Whitmore Lake Pump Station has sufficient capacity to accommodate the additional flow from the proposed school. The conceptual opinion of probable project cost for Service District 4 is $350,000.

Eight Mile Pump Station Upgrade Requirements

The Eight Mile Pump Station will be modified to accept flow only from the Whitmore Lake vicinity, including the Wildwood Lake, Seven Mile, Kelly, and Whitmore Lake High School Development Areas. Assuming the additional REU demand from the new areas, the peak hour flow to the pump station from the Whitmore Lake vicinity will be approximately 2,830-gpm, while the existing firm pumping capacity of the station is 3,300-gpm. This additional flow, combined with the anticipated flow from the North Territorial Vicinity that currently discharges to the Eight Mile Pump Station, will exceed the Eight Mile Pump Station firm pumping capacity. Modifications to the pump station to increase capacity will include transporting sewage flow directly from the North Territorial Pump Station to the WWTP by extending its existing force main. The Whitmore Lake vicinity sewage flow will eventually exceed the capacity of the single 12-inch force main between the Eight Mile Pump Station and the WWTP. When the total dynamic head within the 12-inch force main exceeds the Eight Mile Pump Station's ability to transport the sewage flow, an additional 3,200 linear feet of 16-inch force main will need to be installed parallel to the existing 12-inch. There is an existing 8-inch force main installed parallel to the existing 12-inch, but due to its age and as it has been out of service for approximately 12 years, it is likely that it will be unsuitable for further use. The conceptual opinion of probable project cost for the Eight Mile Pump Station Upgrade is $600,000.

North Territorial Vicinity

The seven development areas located within the North Territorial vicinity and will require three construction projects to accommodate development. The seven areas represent approximately 550-acres of land and have the potential to generate 850 REUs if developed to the seventy percent of maximum density allowed per zoning. Detailed conceptual opinions of probable project cost for each construction project are shown in Appendix C.

- **Service District 5** (*Figure 14*) – this area includes constructing new 12-inch sewer along 5 Mile and Whitmore Lake Roads. The new 12-inch sewer will connect to existing 15-inch gravity line and flow to the North Territorial Pump Station. The construction of this pipe is necessary to accommodate additional flow of 600 REU from the Grand Sakwa Phase I and Whitmore Lake Road Commercial Development Area. The conceptual opinion of probable project cost for Service District 5 is $1,180,000.

- **Service District 6** (*Figure 15*) – this area includes constructing a low-pressure sewer from the US-23 Service Road Commercial and Residential Development Area, as well as a portion of the 6 Mile Commercial District. The new low-pressure system will discharge additional 115 REU flow to an existing 8-inch gravity sewer and flow to the North Territorial Pump Station. The conceptual opinion of probable construction cost for Service District 6 is $530,000.

- **Service District 7** (*Figure 16*) – this area includes constructing 21-inch gravity sewer along North Territorial Road to and south along Nollar Road, with an 8-inch branch line to accommodate additional flow of 120 REU from the Nollar Road Commercial and Residential Development Area. The conceptual opinion of probable construction cost for Service District 7 is $840,000.

North Territorial Pump Station Upgrade Requirements

This pump station has been designed to accommodate flow from the North Territorial Phase I SAD only. As only one 12-inch force main was installed at the time of construction, any flow over 700-gpm, the current firm pumping capacity of the station, will generate head conditions that exceed the pump's operating range. Installation of a second parallel 12-inch force main will raise the capacity of the pump station to 1,400-gpm.

The North Territorial SAD is expected to generate 390,000 gallons (1,500 REU) of average day sewage flow, or a peak hour flow of 950-gpm. As the existing single 12-inch force main can only accommodate 700-gpm of flow, when the firm pumping capacity of the North Territorial Pump Station is reached, an upgrade of an additional 700-gpm pump and 21,000 linear feet of 12-inch force main will be required. The conceptual opinion of probable cost for this upgrade is $2,280,000.

The additions of Six Mile, US-23 Service Road Commercial and Residential, Grand Sakwa Phase I, Whitmore Lake Commercial, and Nollar Road Commercial and Residential Development Areas are expected to generate another 221,000 gallons (850 REU) of average day sewage flow, or a peak hour flow of 540-gpm. The total sewage flow from the North Territorial SAD and the new development areas is 1,490-gpm, which is 90-gpm (140 REU) over the ultimate firm pumping capacity of the North Territorial Pump Station. Any development beyond the 1,500 REU allocated to the North Territorial SAD and 710 REUs from the new development areas will require a new pump station.

When sewage flow from the North Territorial Pump Station exceeds the firm pumping capacity of the Eight Mile Pump Station, the sewage flow from the North Territorial Pump Station will be diverted directly to the WWTP. This will be accomplished by combining the flows from the parallel 12-inch force main with a single 16-inch force main, approximately 3,200 linear feet long. To provide additional pumping capacity to accommodate the an equalization basin that will be part of the expansion of the

Northfield WWTP, modifications to the pump impellers at the North Territorial Pump Station made be required as well. The conceptual opinion of probable cost for this upgrade is $670,000. The combined conceptual opinion of probable cost for all the North Territorial Pump Station upgrades is $2,950,000.

RECOMMENDATION

It is recommended that Northfield Township pursue improvements to the sanitary sewer system that encompass both expansion of new infrastructure and increasing capacity of existing infrastructure. Due to the uncertainty regarding location and timing of new development in the Whitmore Lake and North Territorial vicinities, it is also recommended infrastructure improvements be examined during the design phase not only for the sewage flows from the immediate development areas, but that they also be examined and designed to accommodate the likelihood of additional significant flow from potential adjacent development areas. While over-sizing infrastructure for potential development in the future will represent a higher initial capital cost for the various projects identified, that cost would be less than replacing the new infrastructure or installing additional sewer lines later when future development arrives.

Whitmore Lake Vicinity

It is recommended that several sections of existing sanitary sewer infrastructure in the Whitmore Lake vicinity be upgraded before additional developments are permitted to connect to the sanitary sewer system. Due to the level of existing sewage flow as well as the inflow and infiltration susceptibility of the existing sanitary sewer infrastructure, the sewers have the potential to experience backups due to exceeded capacity in the 25-year or greater rain event. Upgrades of existing sanitary sewer infrastructure as detailed in Service Districts 1, 2, and 4, as well as Option C of Service District 3, should be considered as new development in the Whitmore Lake vicinity arrives. Additionally, the sewage flow rate at the Eight Mile Pump Station should be monitored as additional developments are included to the sanitary sewer system. When the firm pumping capacity of the pump station is reached, sewage flow from the North Territorial vicinity will need to be diverted from the pump station directly to the Northfield WWTP. An increase in sanitary sewage flow from the Whitmore Lake vicinity will require an expansion of the Northfield WWTP.

North Territorial Vicinity

It is recommended that the existing sanitary sewer infrastructure be extended in the North Territorial vicinity as additional developments are permitted to connect to the sanitary sewer system. Extensions of the existing sanitary sewer infrastructure as detailed in Service Districts 5, 6, and 7 should be considered as new development in the North Territorial vicinity arrives. When the existing firm pumping capacity of the North Territorial Pump Station is reached, the pump station will require the upgrade of an additional pump and an additional parallel force main to the Northfield WWTP.

Northfield Wastewater Treatment Plant

The existing Northfield WWTP processes an average flow of 800,000 gallons per day and has a treatment capacity of 1,300,000 gallons per day. An additional 390,000 gallons per day of sewage flow is expected from the North Territorial SAD as development increases. Sewage flows from the additional service areas in the Whitmore Lake and North Territorial vicinities have the potential to generate an additional average flow of 680,000 gallons per day, which totals 1,870,000 gallons per day of existing and potential sewage flow to the WWTP. As the inclusion of the majority of the new service areas identified in the Whitmore Lake and North Territorial vicinities to the sanitary sewer system will require exceed capacity at the Northfield WWTP, we recommend its expansion. We further recommend that Northfield Township monitor development in the development areas identified in the Northfield Church Road vicinity. While sanitary sewage service is not anticipated in these areas in the next twenty years at anticipated growth rates, they have the potential to generate an additional average sewage flow 1,160,000 gallons per day. Inclusion of the Northfield Church Road development areas will likely require a future expansion of the Northfield WWTP beyond what is necessary to accommodate the Whitmore Lake and North Territorial vicinities.

APPENDIX A

Whitmore Lake Vicinity

Conceptual Opinions of Probable Project Cost

Service District 1

Service District 2

Service District 3 – Option A

Service District 3 – Option B

Service District 3 – Option C

Service District 4

Eight Mile Pump Station Upgrade

APPENDIX B

North Territorial Vicinity

Conceptual Opinions of Probable Project Cost

Service District 5

Service District 6

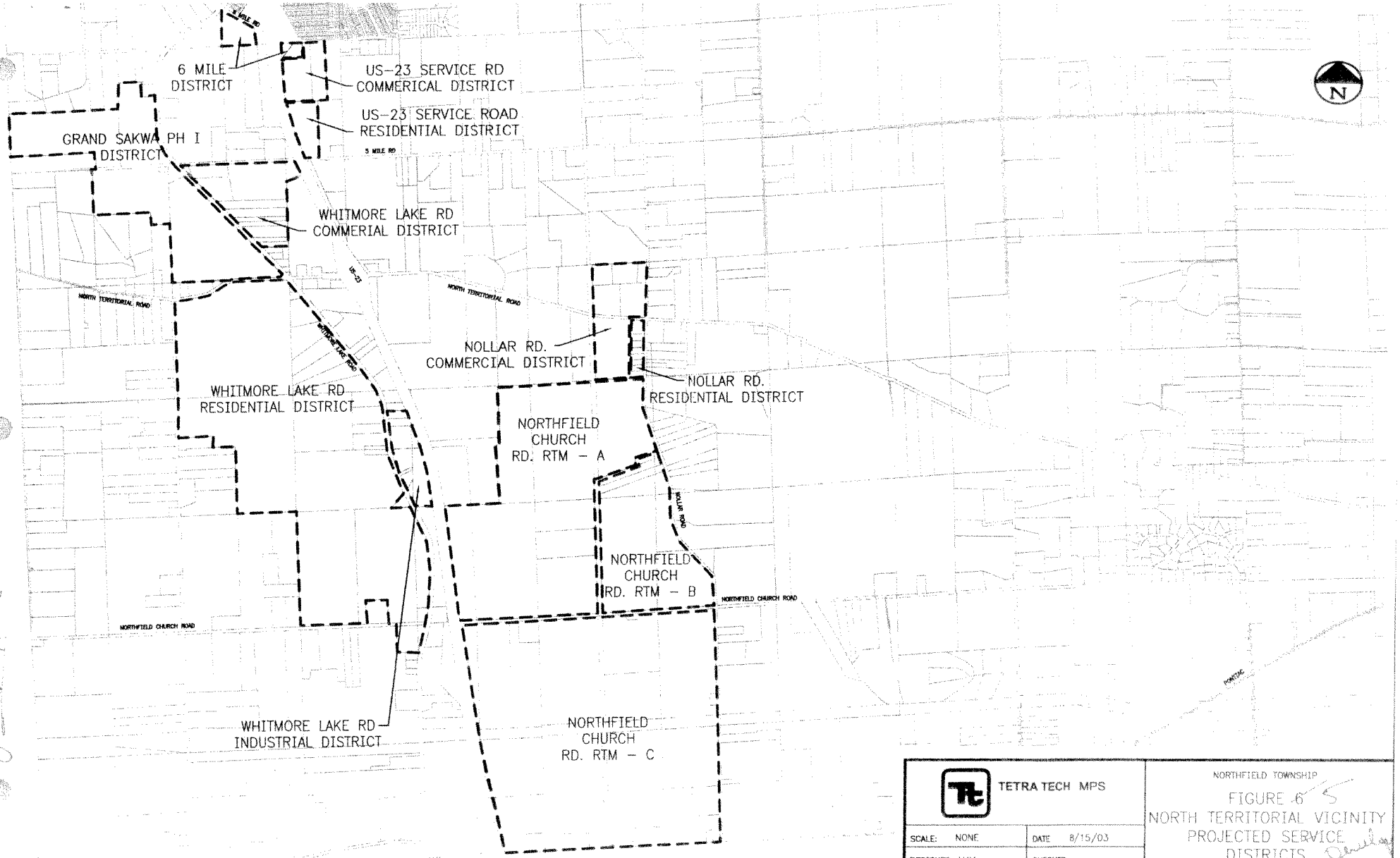
Service District 7

North Territorial Pump Station Parallel Force Main Installation

North Territorial Pump Station Force Main Extension to WWTP

APPENDIX C

Study Figures



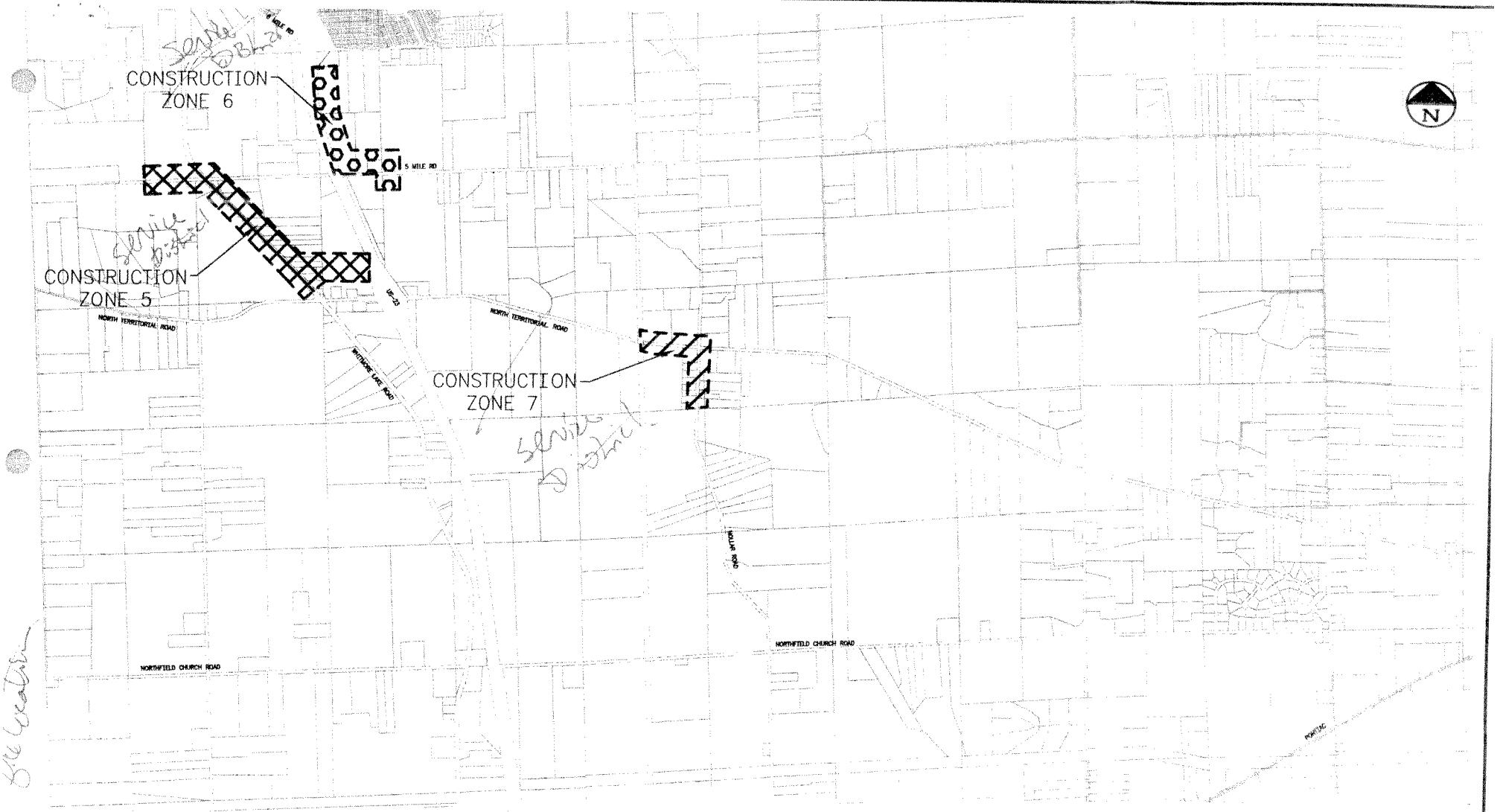
TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 6 5

NORTH TERRITORIAL VICINITY PROJECTED SERVICE DISTRICTS



TETRA TECH MPS		NORTHFIELD TOWNSHIP
SCALE: NONE	DATE 8/15/03	FIGURE 7
DESIGNED MJM	CHECKED	NORTH TERRITORIAL VICINITY CONSTRUCTION ZONES 5-7

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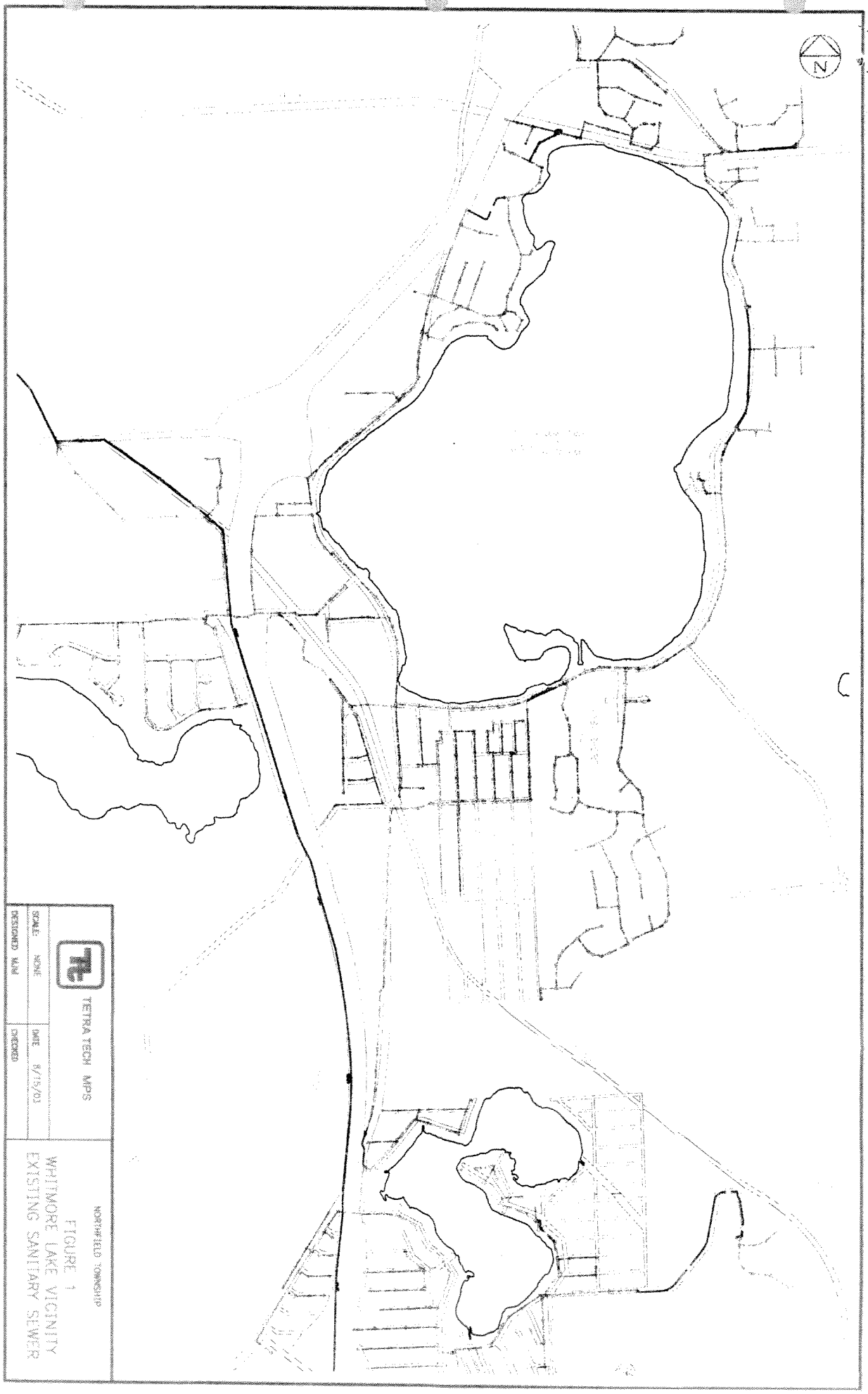

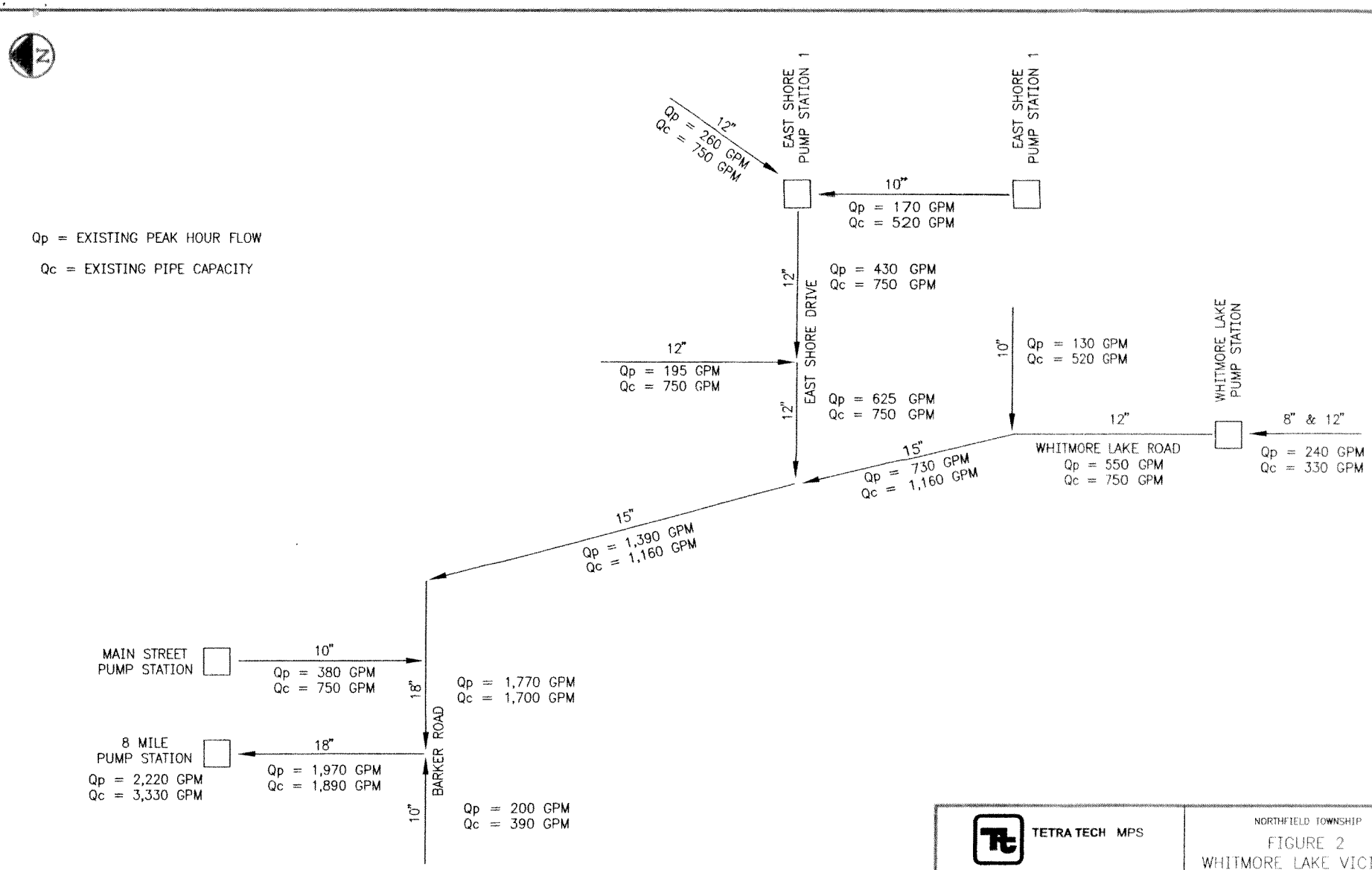

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 2
WHITMORE LAKE VICINITY
EXISTING PEAK FLOWS &
MAXIMUM PIPE CAPACITY

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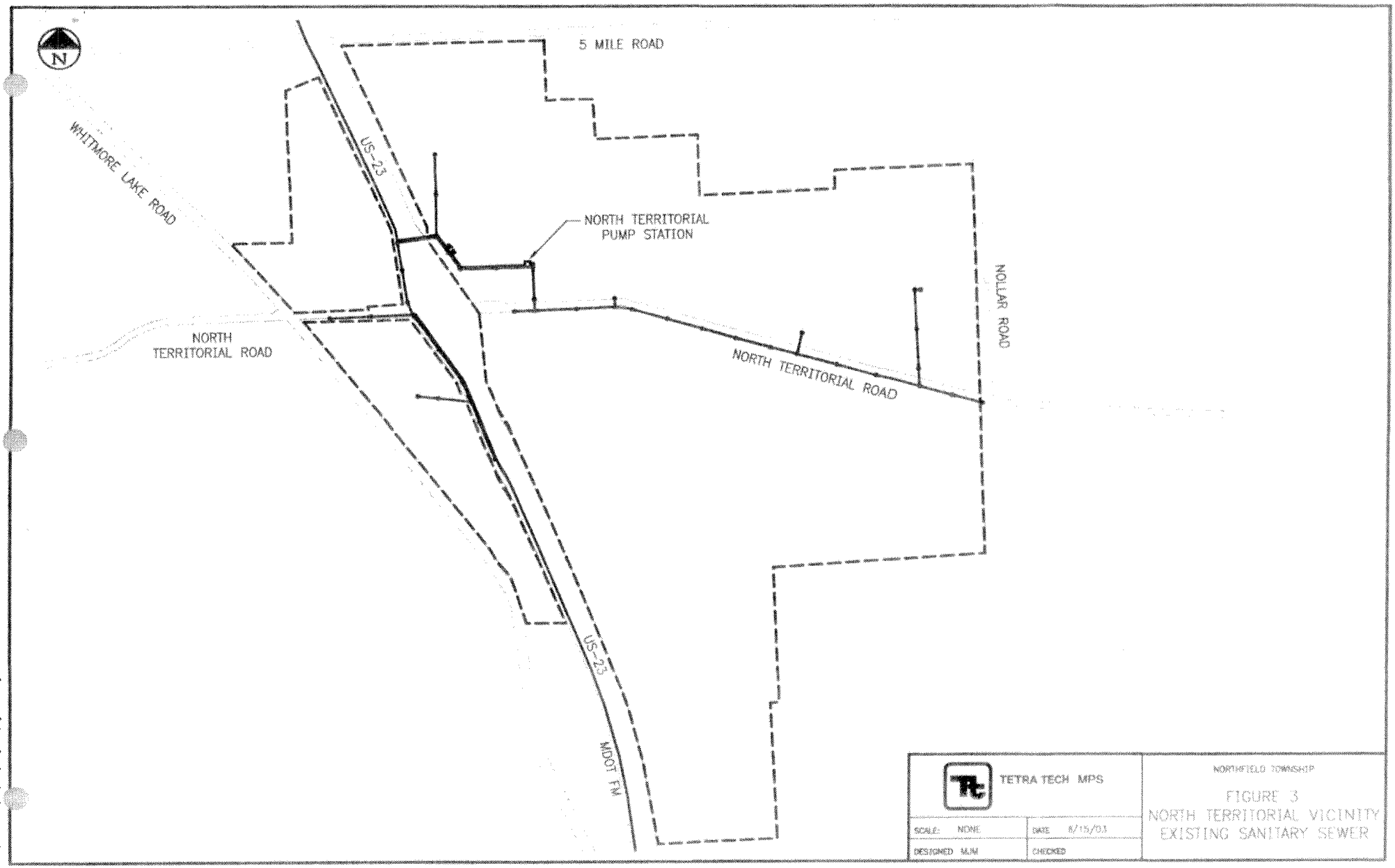
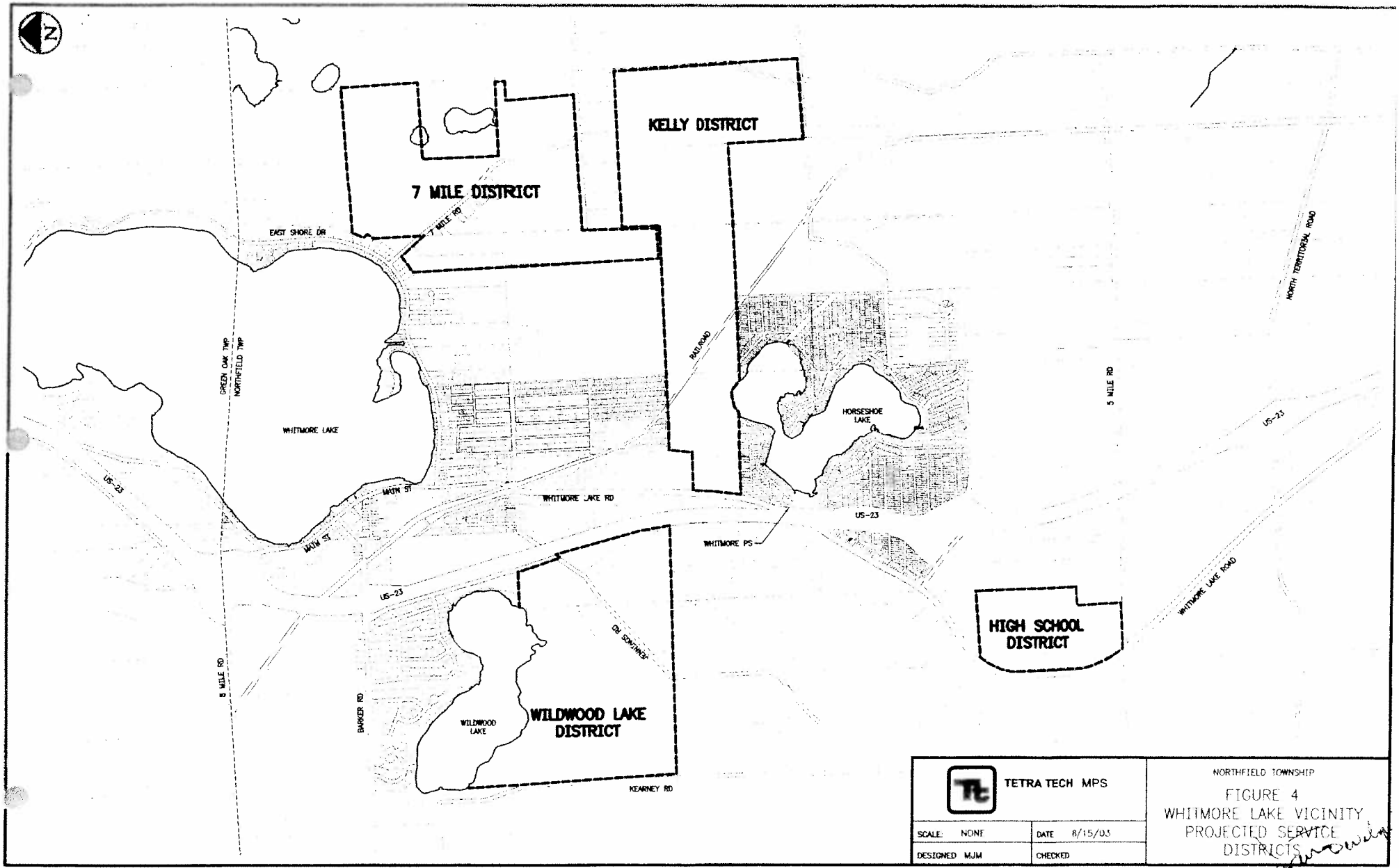
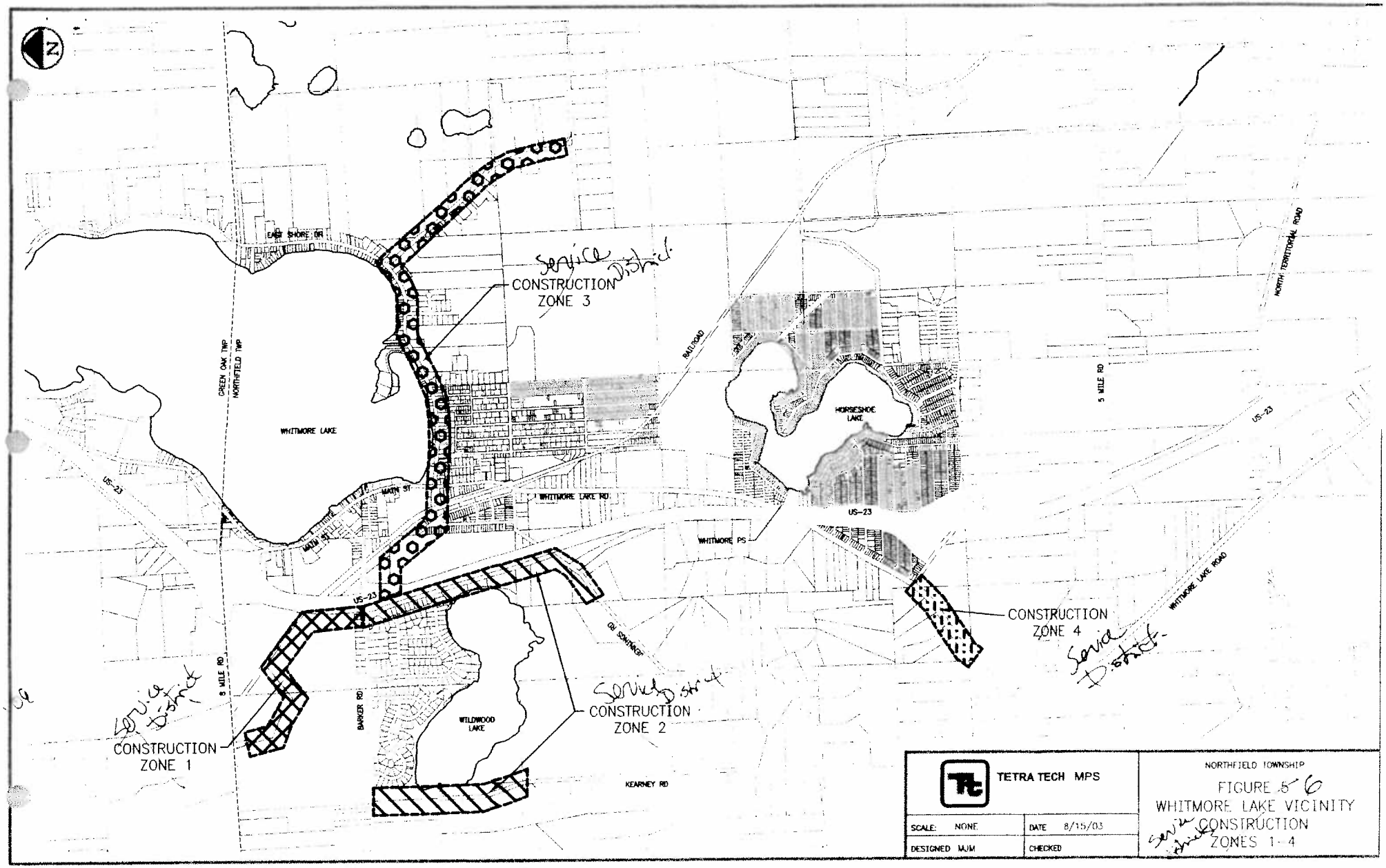
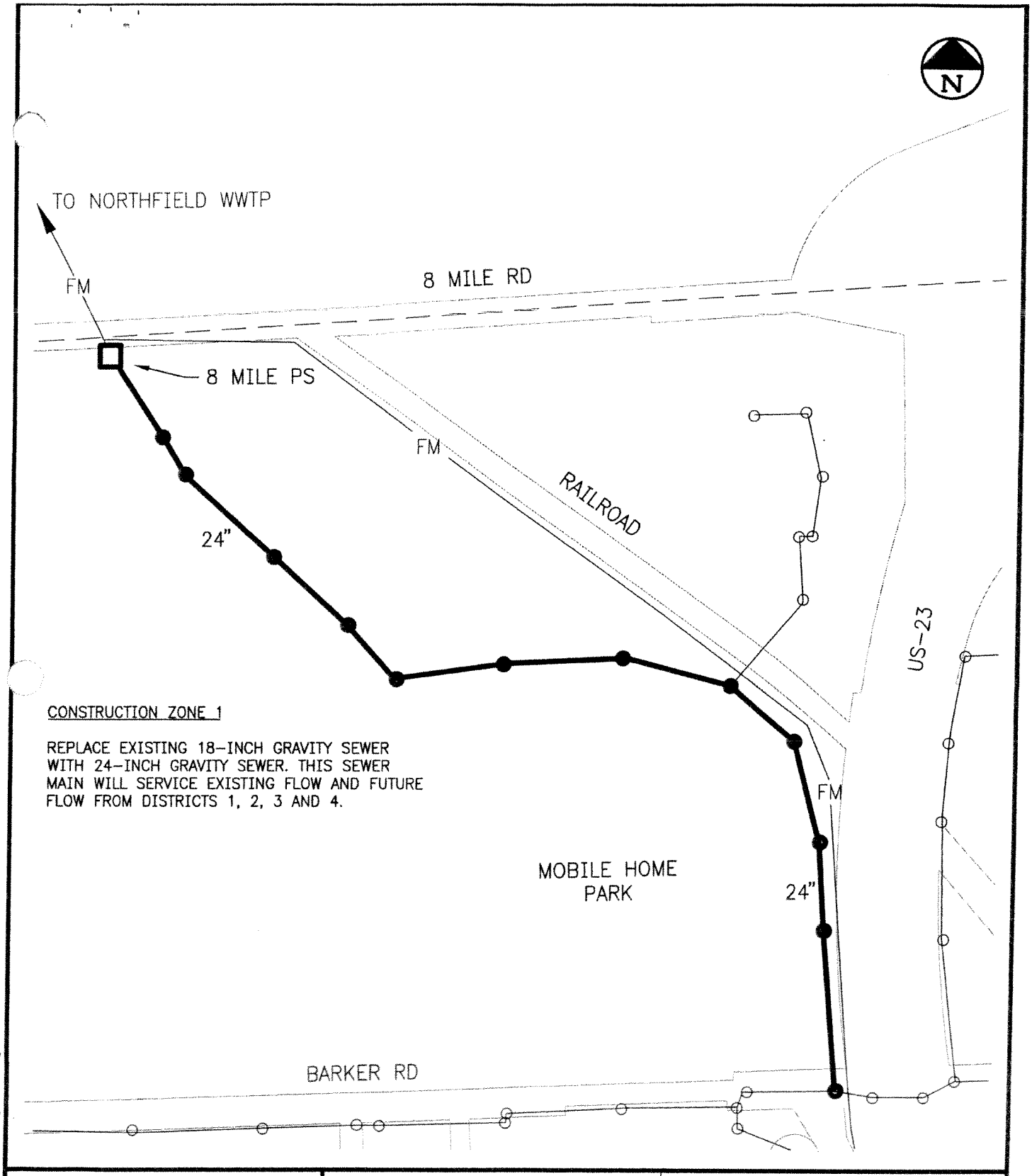

N
5 MILE ROAD
WHITMORE LAKE ROAD
US-23
NORTH TERRITORIAL
PUMP STATION
NOLLAR ROAD
NORTH
TERRITORIAL ROAD
NORTH TERRITORIAL ROAD
US-23
MDOT R/W
TETRA TECH MPS
SCALE: NONE
DATE 8/15/03
DESIGNED MJM
CHECKED
NORTHFIELD TOWNSHIP
FIGURE 3
NORTH TERRITORIAL VICINITY
EXISTING SANITARY SEWER


N
7 MILE DISTRICT
KELLY DISTRICT
HIGH SCHOOL DISTRICT
WILDWOOD LAKE DISTRICT
EAST SHORE DR
7 MILE RD
GREEN OAK TWP
NORTHFIELD TWP
WHITMORE LAKE
MAIN ST
WHITMORE LAKE RD
US-23
RAILROAD
HORSESHOE LAKE
5 MILE RD
NORTH TERRITORIAL ROAD
WHITMORE PS
WHITMORE LAKE ROAD
BARKER RD
WILDWOOD LAKE
KEARNEY RD
TETRA TECH MPS
SCALE: NONE
DATE 8/15/03
DESIGNED MJM
CHECKED
NORTHFIELD TOWNSHIP
FIGURE 4
WHITMORE LAKE VICINITY
PROJECTED SERVICE
DISTRICTS


N
EAST SHORE DR
GREEN OAK TWP
NORTHFIELD TWP
WHITMORE LAKE
MAIN ST
US-23
WHITMORE LAKE RD
RAILROAD
HORSESHOE LAKE
5 MILE RD
NORTH TERRITORIAL ROAD
WHITMORE PS
WHITMORE LAKE ROAD
8 MILE RD
BARKER RD
WILDWOOD LAKE
KEARNEY RD
CONSTRUCTION ZONE 1
CONSTRUCTION ZONE 2
CONSTRUCTION ZONE 3
CONSTRUCTION ZONE 4
TETRA TECH MPS
SCALE: NONE
DATE 8/15/03
DESIGNED MJM
CHECKED
NORTHFIELD TOWNSHIP
FIGURE 5-6
WHITMORE LAKE VICINITY
CONSTRUCTION
ZONES 1-4



LEGEND

'ISTING GRAVITY

UPSIZED GRAVITY

EXISTING FM — FM

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 8
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 1

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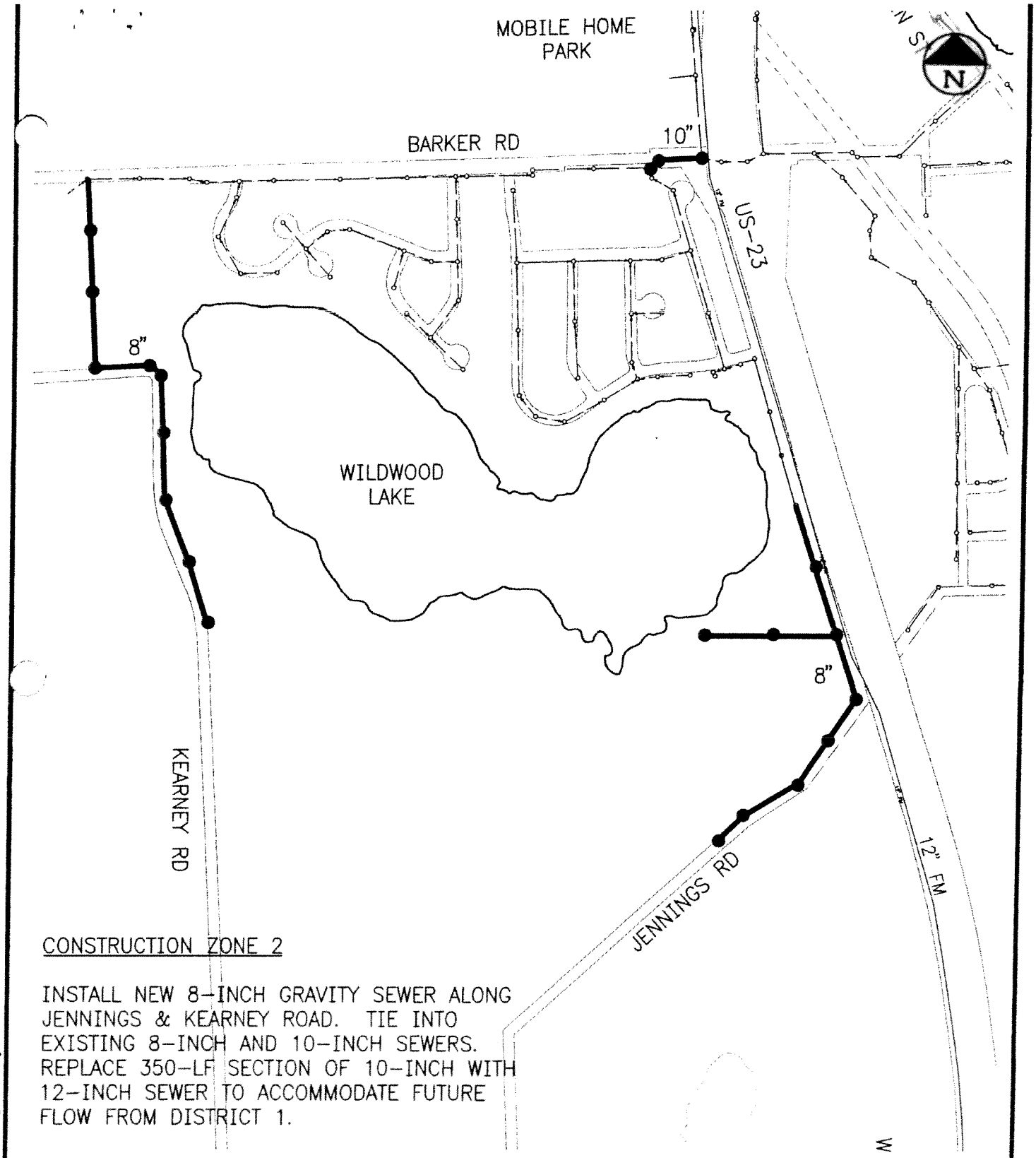


CONSTRUCTION ZONE 2

INSTALL NEW 8-INCH GRAVITY SEWER ALONG JENNINGS & KEARNEY ROAD. TIE INTO EXISTING 8-INCH AND 10-INCH SEWERS. REPLACE 350-LF SECTION OF 10-INCH WITH 12-INCH SEWER TO ACCOMMODATE FUTURE FLOW FROM DISTRICT 1.

LEGEND

ISTING GRAVITY

UPSIZED GRAVITY

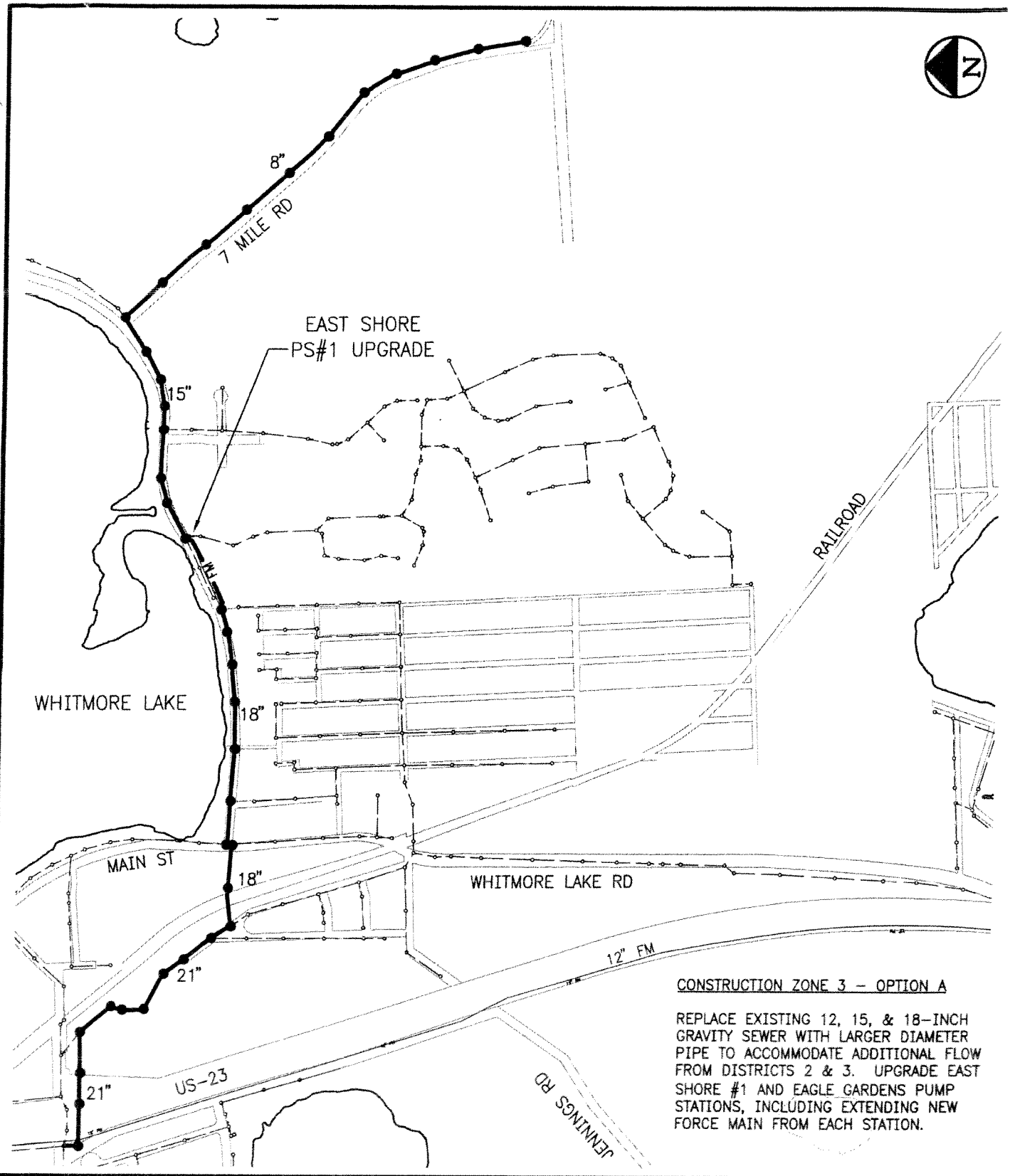
EXISTING FM — FM —

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 9
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 2



CONSTRUCTION ZONE 3 – OPTION A

REPLACE EXISTING 12, 15, & 18–INCH GRAVITY SEWER WITH LARGER DIAMETER PIPE TO ACCOMMODATE ADDITIONAL FLOW FROM DISTRICTS 2 & 3. UPGRADE EAST SHORE #1 AND EAGLE GARDENS PUMP STATIONS, INCLUDING EXTENDING NEW FORCE MAIN FROM EACH STATION.

LEGEND

- EXISTING GRAVITY
- UPSIZED GRAVITY
- EXISTING FM — FM —
- EXISTING FM — FM —

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 10
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 3
OPTION A

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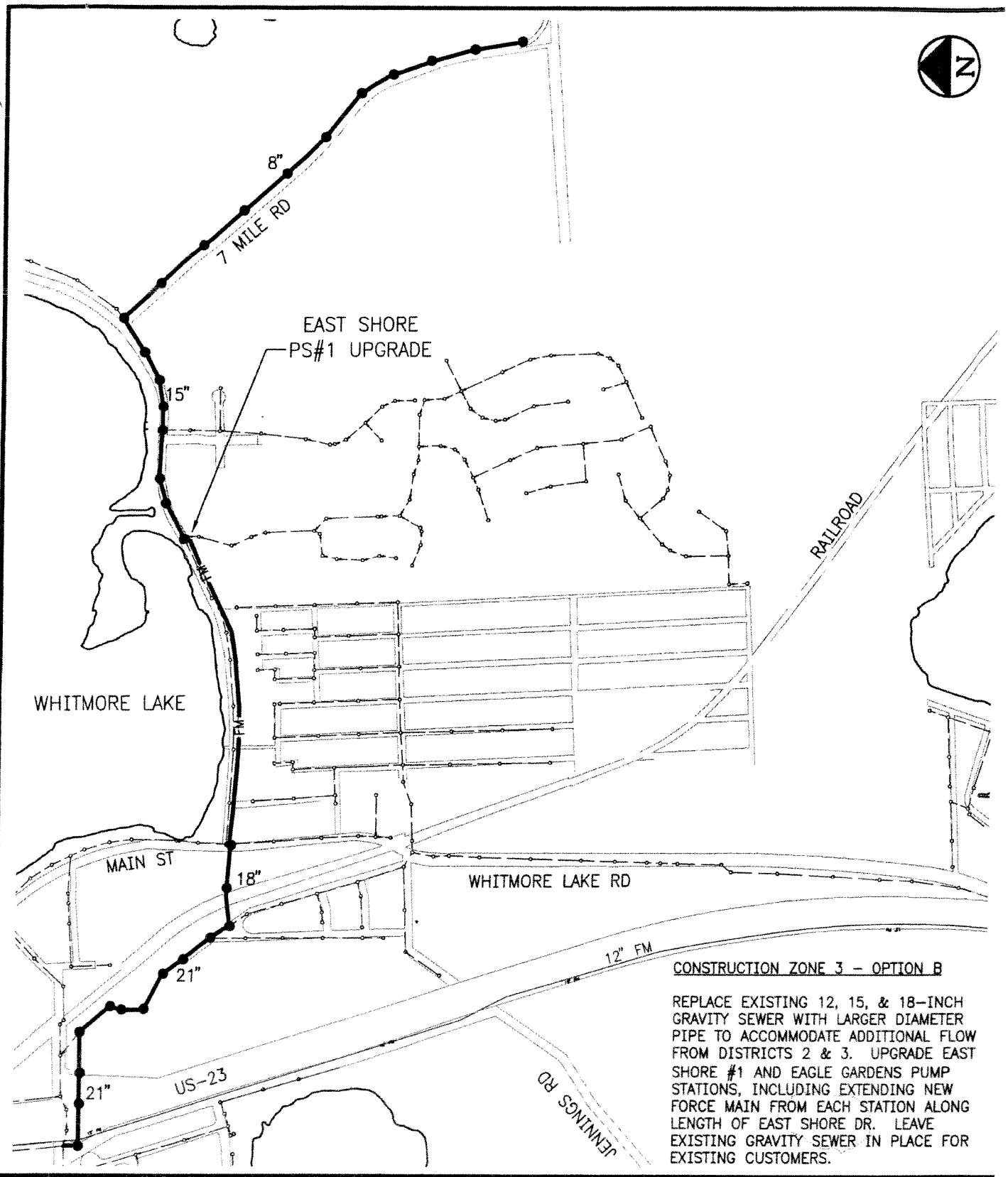

CONSTRUCTION ZONE 3 – OPTION B

REPLACE EXISTING 12, 15, & 18–INCH GRAVITY SEWER WITH LARGER DIAMETER PIPE TO ACCOMMODATE ADDITIONAL FLOW FROM DISTRICTS 2 & 3. UPGRADE EAST SHORE #1 AND EAGLE GARDENS PUMP STATIONS, INCLUDING EXTENDING NEW FORCE MAIN FROM EACH STATION ALONG LENGTH OF EAST SHORE DR. LEAVE EXISTING GRAVITY SEWER IN PLACE FOR EXISTING CUSTOMERS.

LEGEND

- EXISTING GRAVITY
- UPSIZED GRAVITY
- EXISTING FM — FM —
- EXISTING FM — FM —

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 11
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 3
OPTION B

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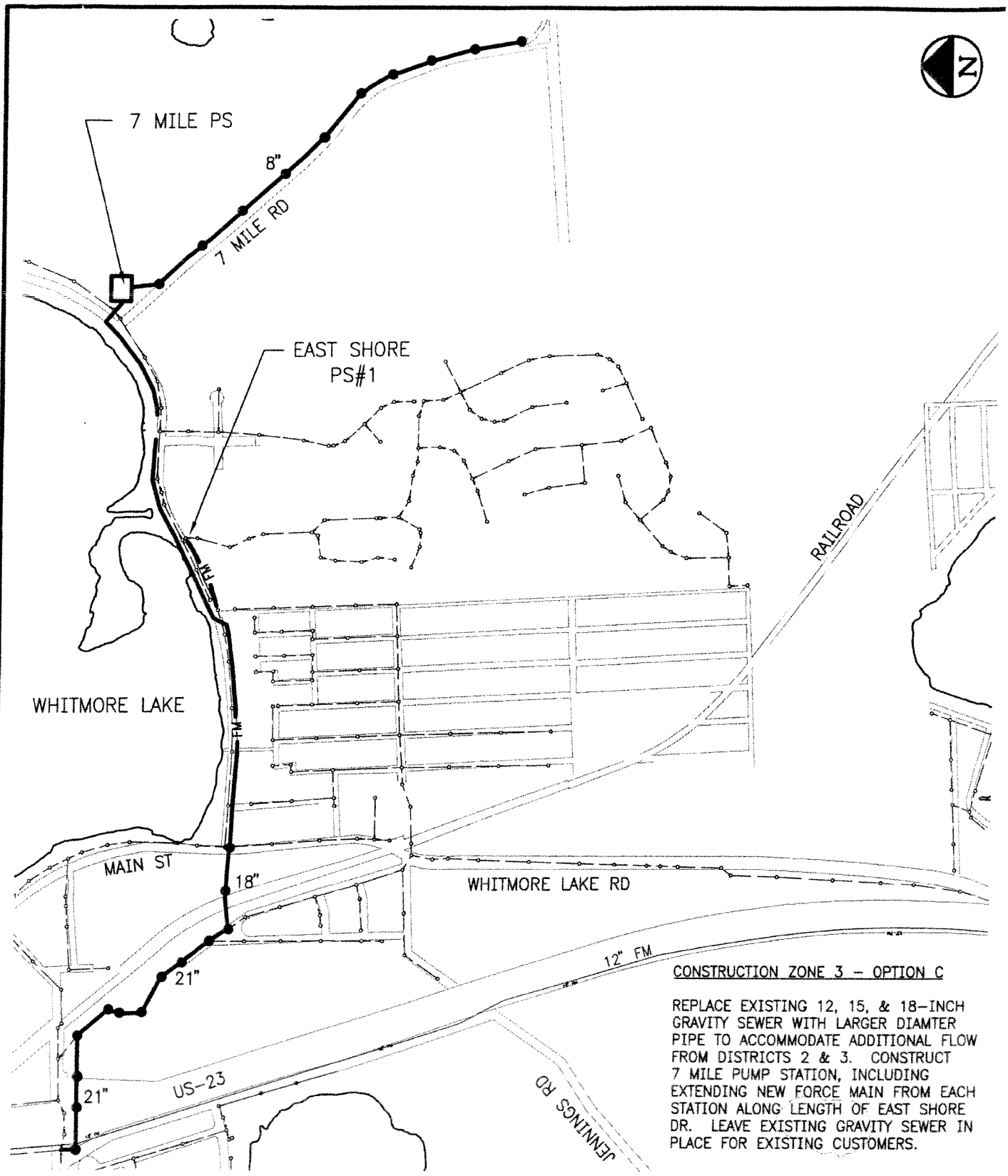

CONSTRUCTION ZONE 3 – OPTION C

REPLACE EXISTING 12, 15, & 18–INCH GRAVITY SEWER WITH LARGER DIAMTER PIPE TO ACCOMMODATE ADDITIONAL FLOW FROM DISTRICTS 2 & 3. CONSTRUCT 7 MILE PUMP STATION, INCLUDING EXTENDING NEW FORCE MAIN FROM EACH STATION ALONG LENGTH OF EAST SHORE DR. LEAVE EXISTING GRAVITY SEWER IN PLACE FOR EXISTING CUSTOMERS.

LEGEND

- EXISTING GRAVITY
- UPSIZED GRAVITY
- EXISTING FM — FM
- EXISTING FM — FM

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 12
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 3
OPTION C

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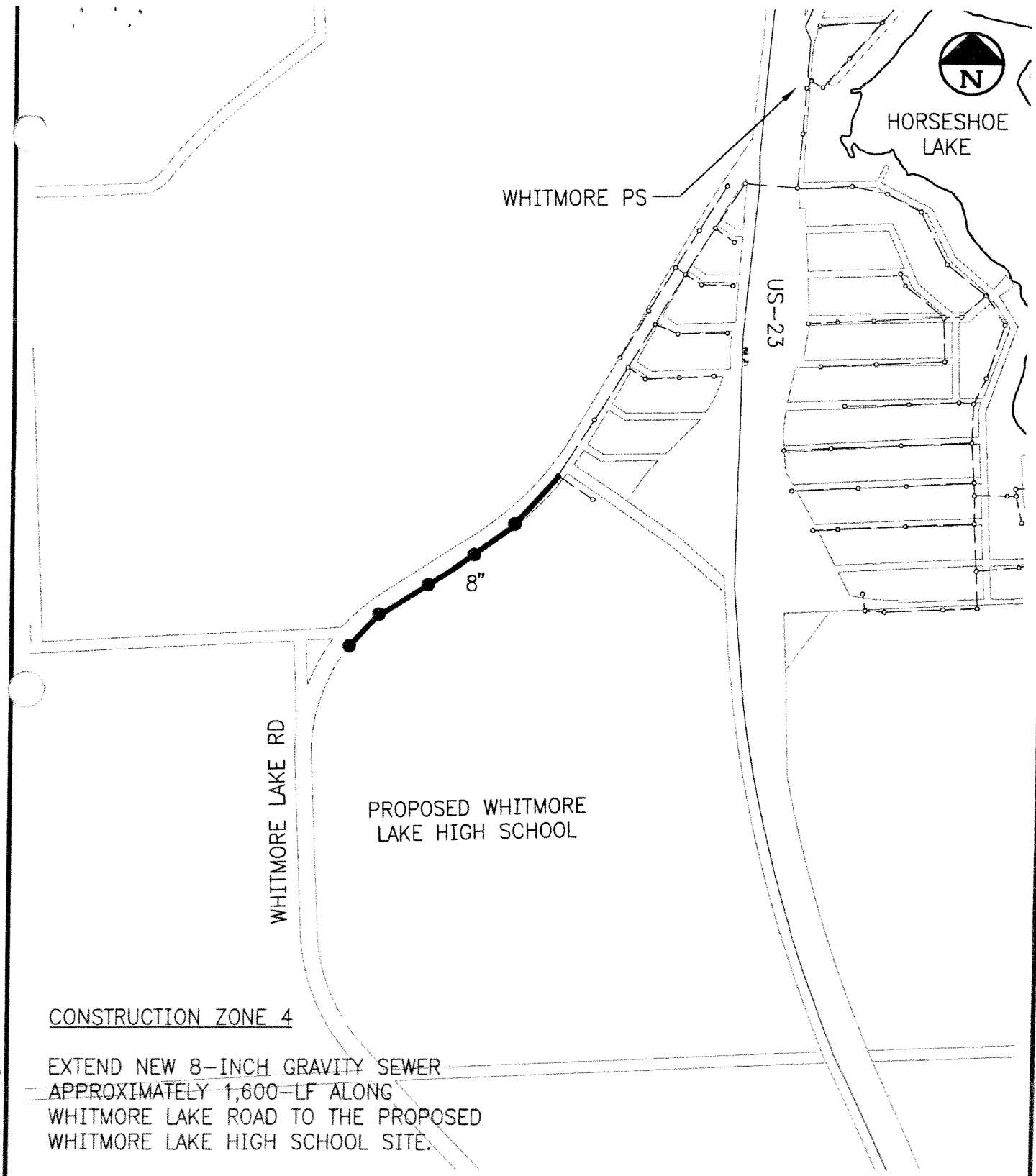


LEGEND

EXISTING GRAVITY

UPSIZED GRAVITY

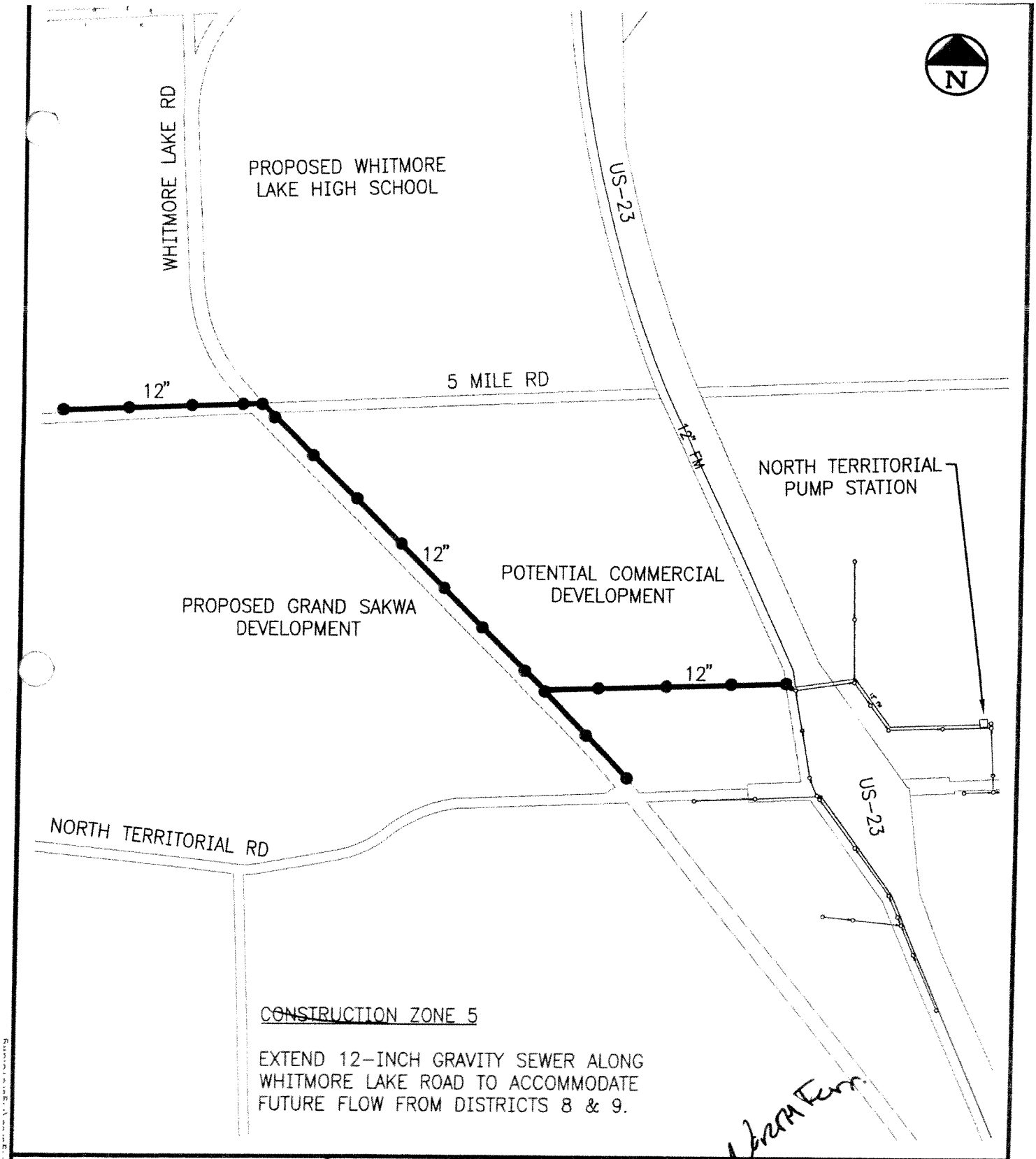
EXISTING FM — FM —

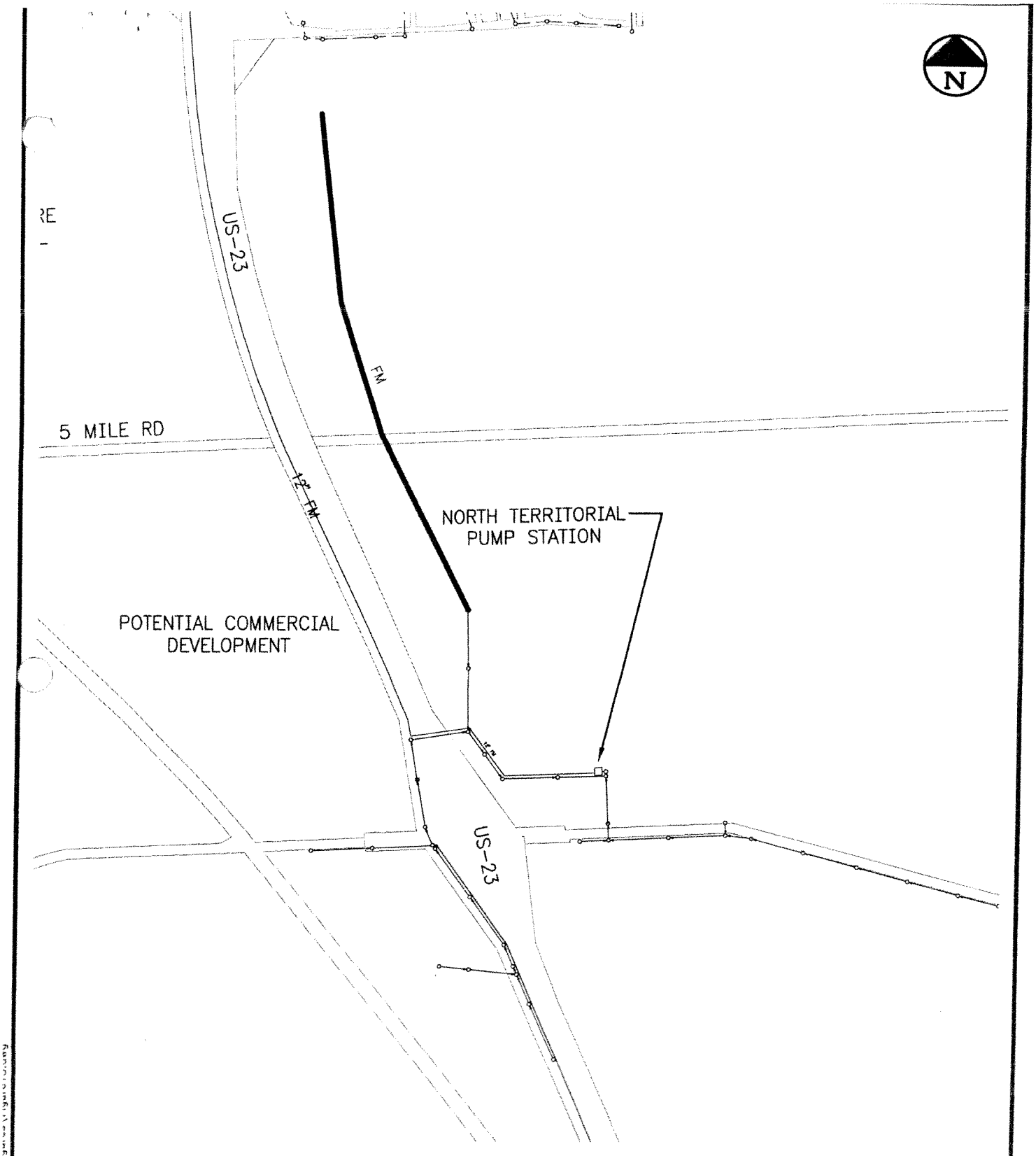
TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

FIGURE 13
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 4


WHITMORE LAKE RD
PROPOSED WHITMORE LAKE HIGH SCHOOL
US-23
5 MILE RD
12"
12" FM
NORTH TERRITORIAL PUMP STATION
12"
POTENTIAL COMMERCIAL DEVELOPMENT
PROPOSED GRAND SAKWA DEVELOPMENT
12"
US-23
NORTH TERRITORIAL RD
CONSTRUCTION ZONE 5
EXTEND 12-INCH GRAVITY SEWER ALONG WHITMORE LAKE ROAD TO ACCOMMODATE FUTURE FLOW FROM DISTRICTS 8 & 9.
LEGEND
EXISTING GRAVITY
UPSIZED GRAVITY
EXISTING FM
FM
TETRA TECH MPS
SCALE: NONE
DATE 8/15/03
DESIGNED MJM
CHECKED
NORTHFIELD TOWNSHIP
FIGURE 14
WHITMORE LAKE VICINITY
CONSTRUCTION ZONE 5



LEGEND

EXISTING GRAVITY

UPSIZED GRAVITY

EXISTING FM — FM

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

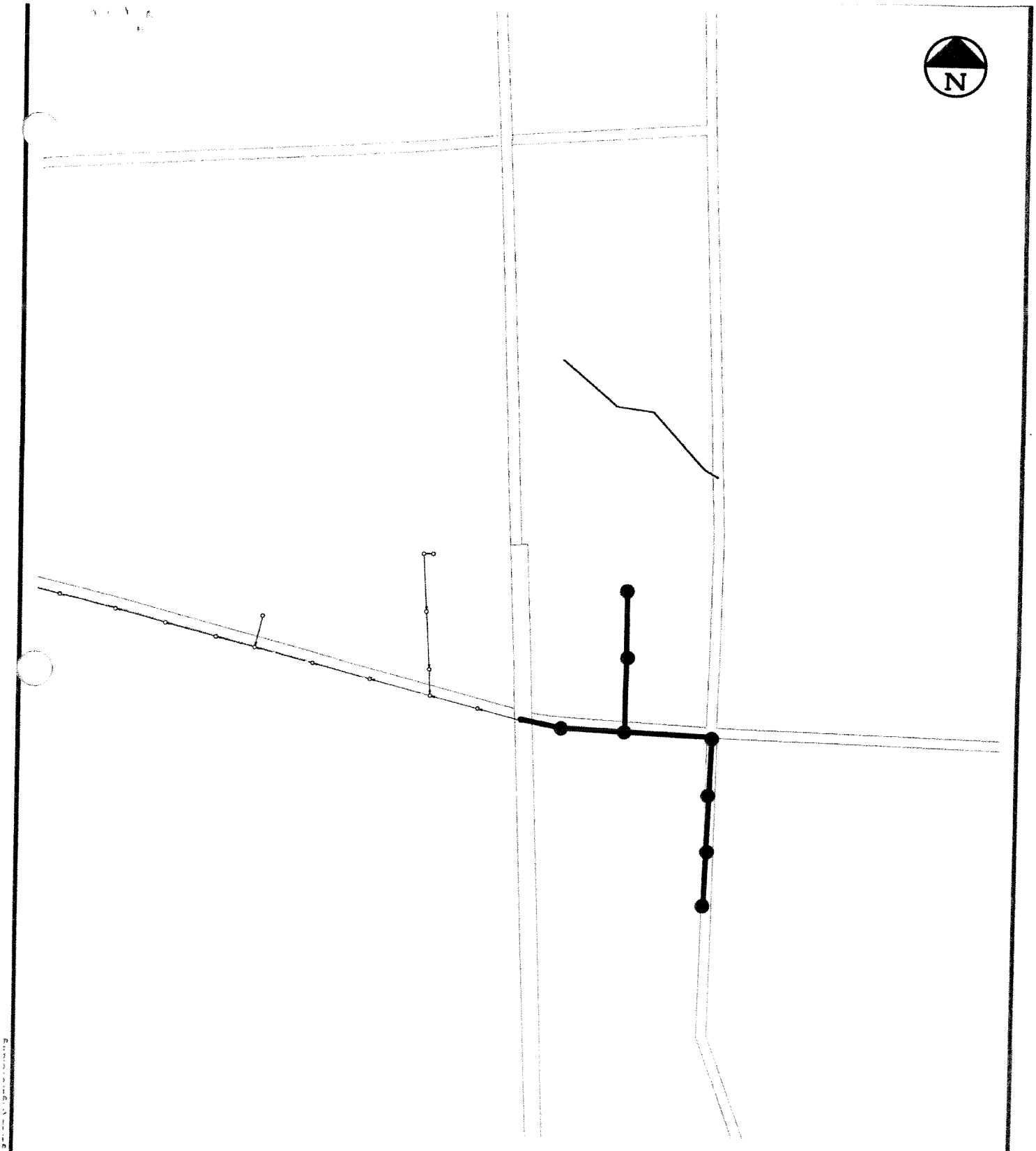
NORTHFIELD TOWNSHIP

NT

FIGURE 15

WHITMORE LAKE VICINITY

CONSTRUCTION ZONE 6



LEGEND

ISTING GRAVITY

UPSIZED GRAVITY

EXISTING FM — FM

TETRA TECH MPS

SCALE: NONE	DATE 8/15/03
DESIGNED MJM	CHECKED

NORTHFIELD TOWNSHIP

NT.

FIGURE 16

WHITMORE LAKE VICINITY

~~CONSTRUCTION~~ ZONE 7

SD1