MIAMI VALLEY REGIONAL PLANNING COMMISSION SANITARY SEWER FEASIBILITY STUDY FINAL REPORT 2015

Prepared for:

The Village of Ludlow Falls

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ABBREVIATIONS

EPA	Environmental Protection Agency
GPD	Gallons Per Day
STEP	Septic Tank Effluent Pump
Mg/L	Milligrams Per Liter
MGD	Million Gallons Per Day
BOD	Biochemical Oxygen Demand
$CBOD_5$	Five Day Carbonaceous Biochemical Oxygen Demand
MVRPC	Miami Valley Regional Planning Commission
D.O.	Dissolved Oxygen
WWTP	Wastewater Treatment Plant
R/D	Recirculation/Dilution
FPA	Facility Planning Area
O,M&R	Operation, Maintenance, and Repair

Chapter 1 - Executive Summary

Purpose of Study

The purpose of this study is to identify, evaluate, and present information pertaining to the existing and future wastewater system within the Village of Ludlow Falls. This study will also gain a sense of the potential growth expected in the area, and present options of different wastewater collection and treatment systems. In addition, the study develops cost-effective alternatives for wastewater service in the area. This study will be used by the Miami Valley Regional Planning Commission (MVRPC) and the Village of Ludlow Falls for the purpose of future planning needs. The Village of Ludlow Falls was selected for this study because of the inability to stay within the health regulations when replacing failing septic tanks.

Alternatives Considered

The existing and future wastewater needs were analyzed to help determine different collection and treatment options. These options include:

Wastewater Collection System Alternatives considered the following:

- Gravity Sewer System
- Septic Tank Effluent Pumping (STEP) System
- Grinder Pump Sewer System
- Vacuum Sewer System

Wastewater Treatment System Alternatives considered the following:

- Construct new Wastewater Treatment Plant (WWTP)
    - Extended Aeration
    - Lagoon
    - Packed Bed Media Filter
- Regionalize with Adjacent Community
    - Transport Wastewater to West Milton

Conclusion

All of the different collection and treatment alternatives, listed above, were analyzed into many different scenarios. Each scenario looked at the cost of the project, O,M&R, and different environmental factors. All of these factors helped determine a best case scenario for the Village of Ludlow Falls.

Recommendation

Based on the cost analysis, the best option for the Village of Ludlow Falls is to construct a gravity collection system and contract with the Village of West Milton for treatment services assuming West Milton will cover the cost of construction of a pumping station and forcemain from Ludlow Falls to West Milton.

The initial capital cost of a gravity collection system is higher than other collection systems, but the annual Operation, Maintenance, and Replacement costs are significantly lower and when a Present Worth analysis is run, these differences become apparent.

Construction of a gravity sewer will also require sewers to be deeper than the other collection systems requiring rock excavation. Rock excavation has been accounted for in the construction estimate. Construction will be slower and cause more disruption, but is temporary and with a responsible contractor, the residents should be able to manage through the construction process, especially considering that a good majority of the sewer lines could be located in alleyways and away from the streets.

Table1-1: Funding Summary

In order to fund the project, the following plan is proposed:

			GRAVITY SEWER WEST MILTON TREATMENT
CUSTOMERS/EDUs			100
PROJECT COST- Collection System			$1,472,510
ANNUAL O,M&R			$0
FINANCING			
CDBG Formula Grant			$30,000
Residential Public Infrastructure Grant			$480,000
OPWC Grant			$400,000
Unsewered Area Assistance Program			$250,000
Local Funds - Capacity Fee $1,500/EDU			$150,000
OPWC Loan	30	0.00%	$162,510
OWDA Loan	30	2.00%	$-
OEPA WPCLF Loan	30	0.00%	$-
Total Financing			$1,472,510
ANNUAL DEBT			
Annual OPWC Payment			$5,417
Annual OWDA Payment			$-
Annual OEPA WPCLF Payment			$-
ANNUAL DEBT PAYMENT			$5,417
DEBT PAYMENT PER MONTH PER EDU			$4.51
O,M&R PAYMENT PER MONTH PER EDU			$-
TOTAL PER MONTH PER EDU (not including treatment charges)			**$4.51**

The above table shows a realistic funding plan for the construction of a gravity collection sewer system. Under this scenario, the majority of the project cost would be covered under grant programs with a much smaller portion through loan.

The bottom line in this table indicates the amount of debt payment for each customer. This debt payment will be in addition to the standard monthly billing to the Village of West Milton. West Milton recently enacted a 30% surcharge on out of town customers. With this surcharge, the rate to Ludlow Falls would be as shown in the following table:

Table1-2: Monthly Debt Payment

Operation Charge	Consumption Charge (per 1,000 Gallons)
$8.79	$9.14

Each resident can calculate what their typical sewer bill would be based on their current water bill. For simplicity, the table below is provided based on a monthly water usage between 2,000 gallons per month to 6,000 gallons per month.

Table1-3: Typical Monthly Sewer Payment

Water Usage (gal/month)	Operation Charge	Consumption Charge	Debt Payment	Total Monthly Bill
2,000	$8.79	$18.28	$4.51	$31.58
3,000	$8.79	$27.42	$4.51	$40.72
4,000	$8.79	$36.56	$4.51	$49.86
5,000	$8.79	$45.70	$4.51	$59.00
6,000	$8.79	$54.84	$4.51	$68.14

Chapter 2 - Introduction

Background

In accordance with the Water Pollution Control Act amendments of 1972, the Miami Valley Regional Planning Commission (MVRPC) serves as the Designated Water Quality Planning Agency for the 5-county Miami Valley Region. In this role, MVRPC prepared and continually maintains an Areawide Water Quality Management Plan (AWQMP), also known as the 208 Plan. Also, under Section 208 of the EPA's Clean Water Act, MVRPC has the responsibility for reviewing and approving individual Wastewater Treatment Facility Plans and their associated Facility Planning Areas. Within the AWQMP for Miami County, the Village of Ludlow Falls, among other communities, was designated as a localized area of concern as noted by the Miami County Health District, Miami County Soil and Water Conservation District and Ohio EPA as a result of failing septic systems

In 2014, MVRPC received a grant sponsored by Ohio EPA to evaluate and provide wastewater collection and treatment alternatives for several communities within the 5-county region agreeing to take part in the study. The Village of Ludlow Falls elected to become one of the study participants. This report is the result of that commitment.

Objective

The objective of this study is to provide a cost-effective and environmentally sound wastewater collection and treatment system for the Village of Ludlow Falls planning area. The design of the system will take the growth and development of the area into consideration. The new system will meet the requirements established by the Ohio Environmental Protection Agency.

Planning Area

The Village of Ludlow Falls is a small incorporated village located in the southwestern corner of Miami County in Union Township. Ludlow Falls is approximately 3 miles north of the Village of West Milton and approximately 9 miles southwest of the City of Troy. The planning area for Ludlow Falls includes all property within the corporation limits of Ludlow Falls as well as a small area located just north of the Village. There are currently 88 service locations including a missionary church camp in the Village and 7 homes located just north of the Village. Figure 2-1 illustrates the planning area for Ludlow Falls.

Scope of Study

A brief summary of the scope of this study is presented below. The planning period for this study is 25 years or through the year 2040.

<u>Data Collection and Review</u> - Data relevant to the Planning Area was collected, reviewed and analyzed. This data included previous studies concerning wastewater needs.

Develop Population & Sewer Needs Forecasts – Based on historical and existing population data, the projected future wastewater needs for the designated study area over a 25-year planning period was developed.

Factors such as cost, environmental impacts, regulatory and permitting requirements must be taken into consideration when evaluating wastewater collection and treatment alternatives.

Develop and Evaluate Alternatives- In establishing the criteria for the design of wastewater systems, several factors were considered. These included the length of time the facilities should serve before replacement or expansion is necessary, the population to be served, the type of customers to be served (i.e. residential, commercial, industrial, etc.) and the projected wastewater flows (both average daily and peak hourly flows) over the span of the planning period.

Draft Report- Based on the work generated in the above tasks, a Draft Report summarizing the findings and recommendations is to be prepared. The draft report will be reviewed with the Village and other stakeholders and comments/ feedback will be incorporated into the Final Report.

Final Report- After review of the draft report and revisions made pursuant to comments received, a final report will be prepared and delivered to the Village, MVRPC, and the Ohio EPA.

Methodology

Brief descriptions of the methods used in the preparation of this study are shown below.

Study Area Boundary- The general study area was determined by MVRPC and was refined during the first progress meeting.

Projections of Sewer Needs for the Study Area - The following calculations were used to determine the average daily flow and the peak hourly flow.

Wastewater Systems

Average Daily Flow = Population x 100 gallons/day/person

Peak Hourly Flow = Average Daily Flow x 4.0 peaking factor

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VILLAGE OF LUDLOW FALLS

MVRPC UNSEWERED COMMUNITIES

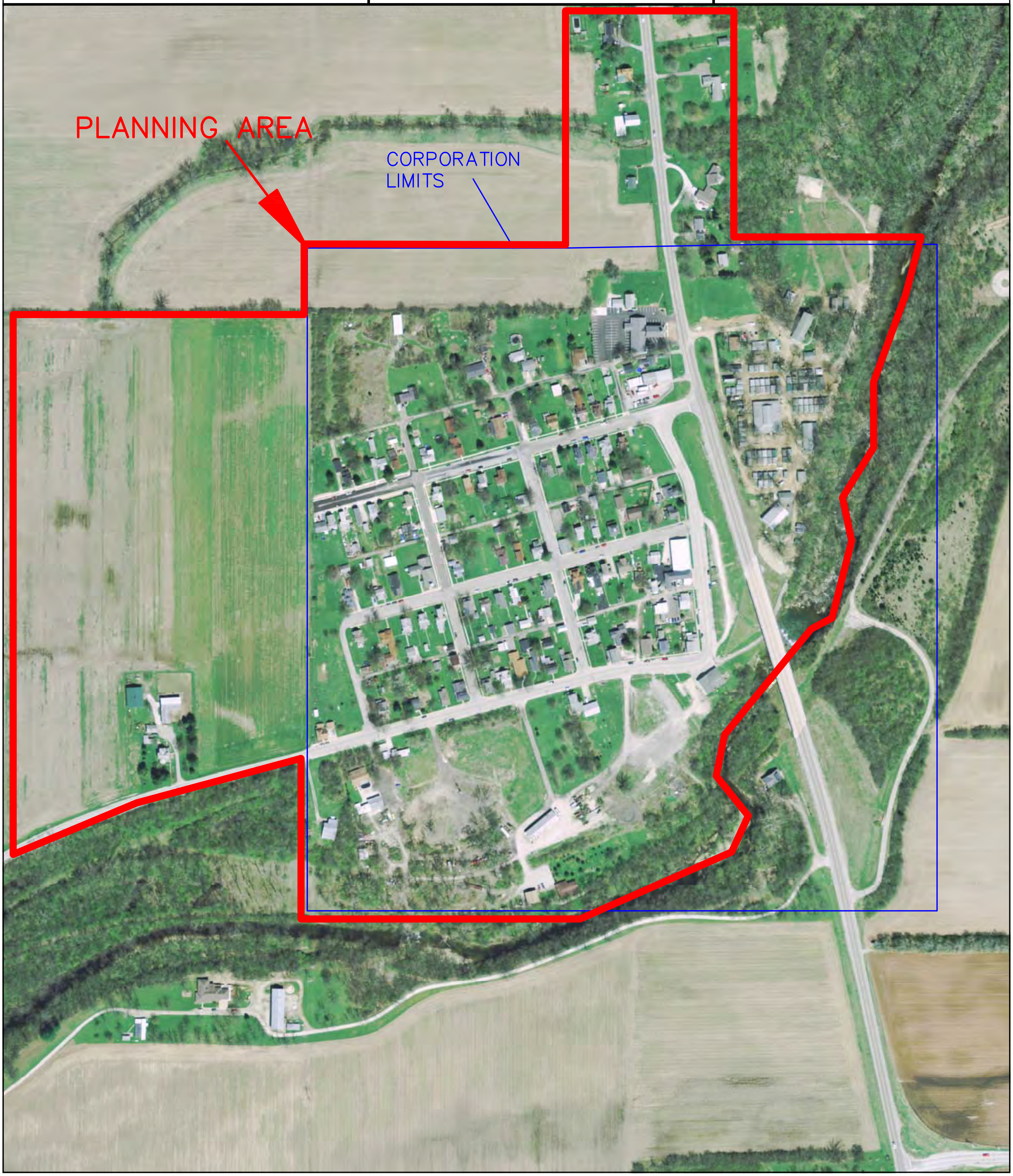
FIGURE 2-1: PLANNING AREA

GRAPHIC SCALE

0 200 400

(IN FEET)

1 inch = 400 ft.



Existing Water Systems

The Village of West Milton owns and operates the public water treatment and distribution system (PWSID # OH5501711) in the Village of Ludlow Falls. The system was constructed in the early 1960s. West Milton purchases bulk water from the City of Troy. The City of Troy's water supply comes from buried valley sand and gravel aquifers associated with the Great Miami River.

The following table was generated from information provided by the Village of West Milton showing water consumption for the Ludlow Falls areas. Water usage ranges from a low of approximately 9,000 GPD to a high of 28,000 GPD over the last four years. Average annual daily water consumption is approximately 13,500 GPD which equates to approximately 4,000 Gallons per Month per Home.

Table 3-1: Water Usage

	2011		2012		2013		2014	
	MONTHLY USAGE (1,000 GAL)	DAILY USAGE (GAL)	MONTHLY USAGE (1,000 GAL)	DAILY USAGE (GAL)	MONTHLY USAGE (1,000 GAL)	DAILY USAGE (GAL)	MONTHLY USAGE (1,000 GAL)	DAILY USAGE (GAL)
JAN	395	13,167	286	9,533	523	17,433	419	13,967
FEB			311	10,367	261	8,700	329	10,967
MAR	403	13,433	312	10,400	277	9,233	273	9,100
APR	335	11,167	575	19,167	320	10,667	596	19,867
MAY	422	14,067	414	13,800	661	22,033	408	13,600
JUN	841	28,033	774	25,800	554	18,467	362	12,067
JUL	522	17,400	498	16,600	537	17,900	370	12,333
AUG	594	19,800	343	11,433	398	13,267	296	9,867
SEP	349	11,633	317	10,567	313	10,433	342	11,400
OCT	320	10,667	265	8,833	327	10,900		
NOV	339	11,300	292	9,733	346	11,533		
DEC	340	11,333	295	9,833	349	11,633		
AVERAGE	**442**	**14,727**	**390**	**13,006**	**406**	**13,517**	**377**	**12,574**

Water distribution within the Village is generally 6-inch Ductile Iron. The Village also has fire hydrants located throughout the Village with adequate spacing for fire protection.

The following table shows the monthly water rates for the Village of Ludlow Falls. Based on a typical homeowner using 4,500 Gallons Per Month, the typical Ludlow Falls customer monthly bill is $37.88. Figure 3-1 shows the layout of the existing water system, which was provided by the Village of West Milton.

Table 3-2: Monthly Water Rates

OPERATION CHARGE	CONSUMPTION CHARGE per 1,000 gal	METER FEE
$10.50	$5.45	$2.85

Existing Wastewater Systems

A centralized collection and treatment system does not exist within the Village of Ludlow Falls. Each residence and business is responsible for its own on-site treatment system. Many of these on-site systems are comprised of steel or masonry septic tanks with minimal leaching fields or even direct or indirect connections to drainage tiles. Many of these on-lot treatment systems are failing and discharging raw or partially treated sewage to drainage swales which finds its way into the water table and adjacent streams. These systems do not meet Ohio EPA discharge standards.

Environmental Conditions

The environmental conditions in Miami County and the study area are important factors in determining the wastewater collection and treatment alternatives that are viable for the study area. The environmental conditions are analyzed in the following sections.

Soils

The majority of the study area falls within two soil classifications. The two classifications in the Village of Ludlow Falls are Milton and Miamian associations. The following information is generated from the United States Department of Agriculture National Resource Conservation Service. Figure 3-2 shows all the soil associations within the Ludlow Falls Planning area.

The Milton soil series is the dominant soil series covering approximately 55 percent of the planning area. The slope for this soil, primarily a flat terrain, ranges from 2-6 percent. These slopes help this soil generate a well drained natural grainage class. The runoff flows at a moderate rate leading to no flooding or ponding. The moderate amount of runoff keeps the available water storage in profile low at about 4.2 inches. The depth to the water table in this location is more than 80 inches in depth. One limited factor for this soil is the depth to lithic bedrock is approximatly20-40 inches below the surface.

The second leading soil class in the planning area is Miamian. This class has the same features listed above for the Milton soil class except this soil can retain more water and has a greater depth to lithic bedrock. The available water storage in profile is about 7.3 inches, which is a moderate rating. The depth to the bedrock is deeper than the Milton class at approximately 40-80 inches deep.

Topography

The topography is relatively flat with a general slope down going from West to East. The highest elevation in the study area is 920 feet on the west side and the lowest elevation is 800 feet located on the east side in the campsite near Ludlow Creek. These elevations are about one mile away from each other.

The elevation of the bedrock in the Village is close to the surface elevation in some areas. In these areas the depth to the bedrock could be as close as 4 feet. This will come into effect when constructing a sewer system, especially a Gravity system, because the depth of the sewer line could be as deep as 16 feet. Figures 3-3 and 3-4 indicate the bedrock elevation in the Village.

Surface Water

There is only one identifiable body of water within the area. It is a stream known as Ludlow Creek, located east and south of the Village. Ludlow Creek contains falls known also as “Ludlow Falls” in the southeast corner of the Village. Ludlow Creek flows to the northeast for approximately 1 mile until it joins Stillwater River. This stream could be a possible discharge point for a future wastewater treatment plant.

Wetlands

There are a few wetlands identified by the National Wetlands Inventory Program in the area. These wetlands do not interfere with the planning of the collection or treatment systems. The location of these wetlands can be found in Figure 3-5.

Flood Hazard Area (100 yr. flood plain)

Flood plains are formed by the periodic overflow of the stream and its resulting sediment deposition and realignment of the stream course. They are characteristically flat and fertile, and can extend over large areas of land.

Although flood plains are often perceived as desirable development sites, they are potentially hazardous in terms of loss of life, property, and land. The 100-year flood reoccurrence interval is most commonly accepted as a reasonable measure of flood-prone areas. Figures 3-6 and 3-7 show the aerial extent of the 100-year flood of the Ludlow Creek stream and its tributaries, as identified on the Federal Emergency Management Agency (FEMA) map.

Land Use

The planning area has three different land categories. The three different categories for this study are residential, vacant/agriculture, and commercial. Figure: 3-7 shows the locations of each of the land categories.

The residential category, which is the largest, is comprised of single-family dwellings, multi-family dwellings, and vacant residences with a potential of human habitation. The primary residential area lies within the corporation limits of the Village of Ludlow Falls with additional residential areas just outside of the corporation limits. Residential land use in the planning area is comprised of approximately 24 acres, which is 51 percent of the total area.

The second largest land use category, vacant/agriculture, is composed of 12 acres and is approximately 26 percent of the land.

Commercial land comprises the third largest percentage of acres in the planning area. Commercial land is located mostly within the Village of Ludlow Falls along Covington Avenue. This land is comprised of lots used to conduct business instead of homes, the Missionary Church Camp, and Churches in the area. Commercial land use makes up approximately 23 percent of the planning area and contains approximately 11 acres.

Table3-3: Existing Land Use

LAND USE TYPE	ACREAGE	PERCENTAGE
Residential	24	51
Vacant/ Agriculture	12	26
Commercial	11	23
Total	47	100

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FIGURE 3-1: EXISTING WATER SYSTEM

GRAPHIC SCALE

0 150 300

(IN FEET)

1 inch = 300 ft.

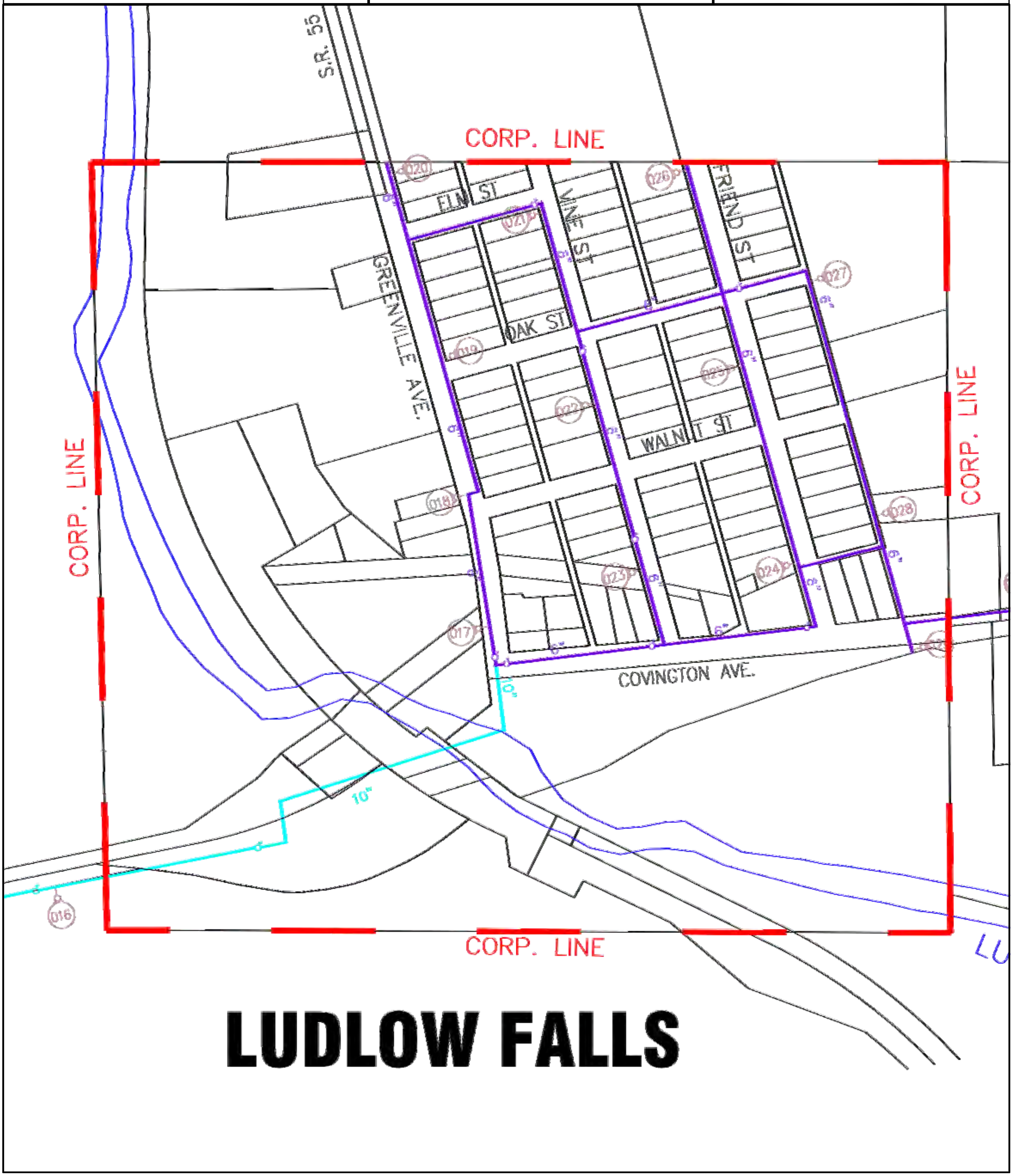

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FIGURE 3-2: AREA SOILS

GRAPHIC SCALE
0 400 800
(IN FEET)
1 inch = 800 ft.

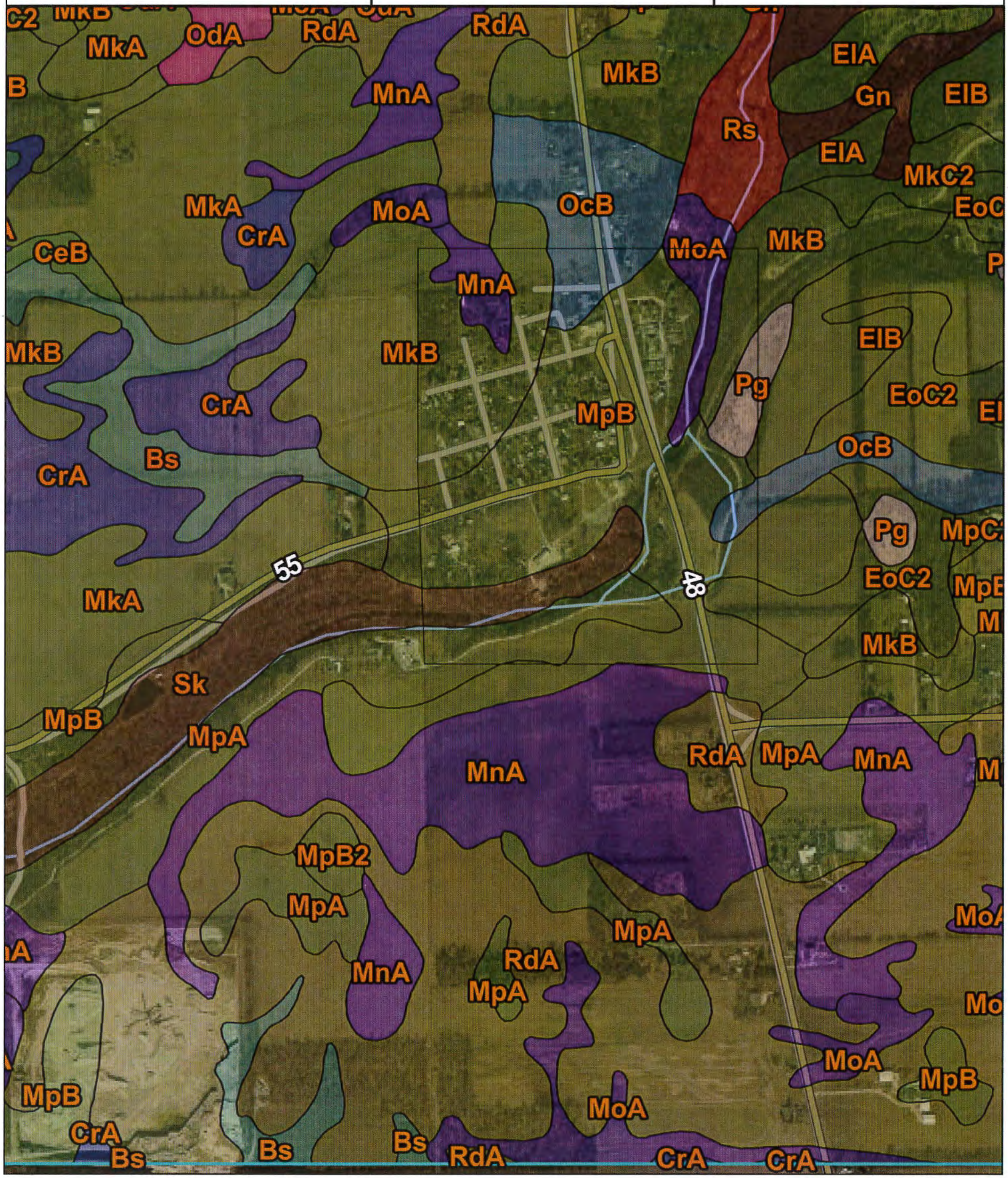

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FIGURE 3-3: AREA BEDROCK-NORTH

GRAPHIC SCALE

0 300 600

(IN FEET)

1 inch = 600 ft.

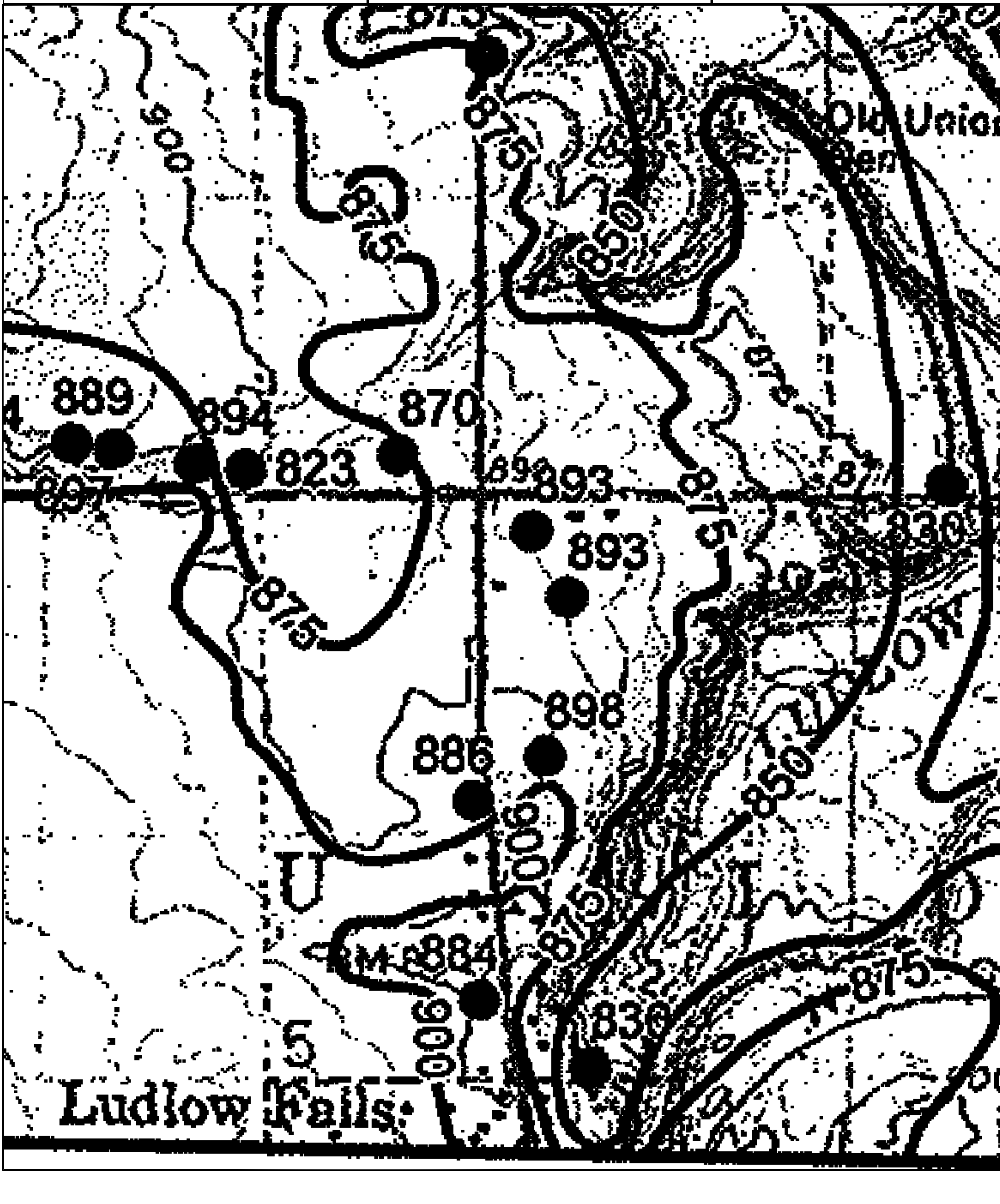

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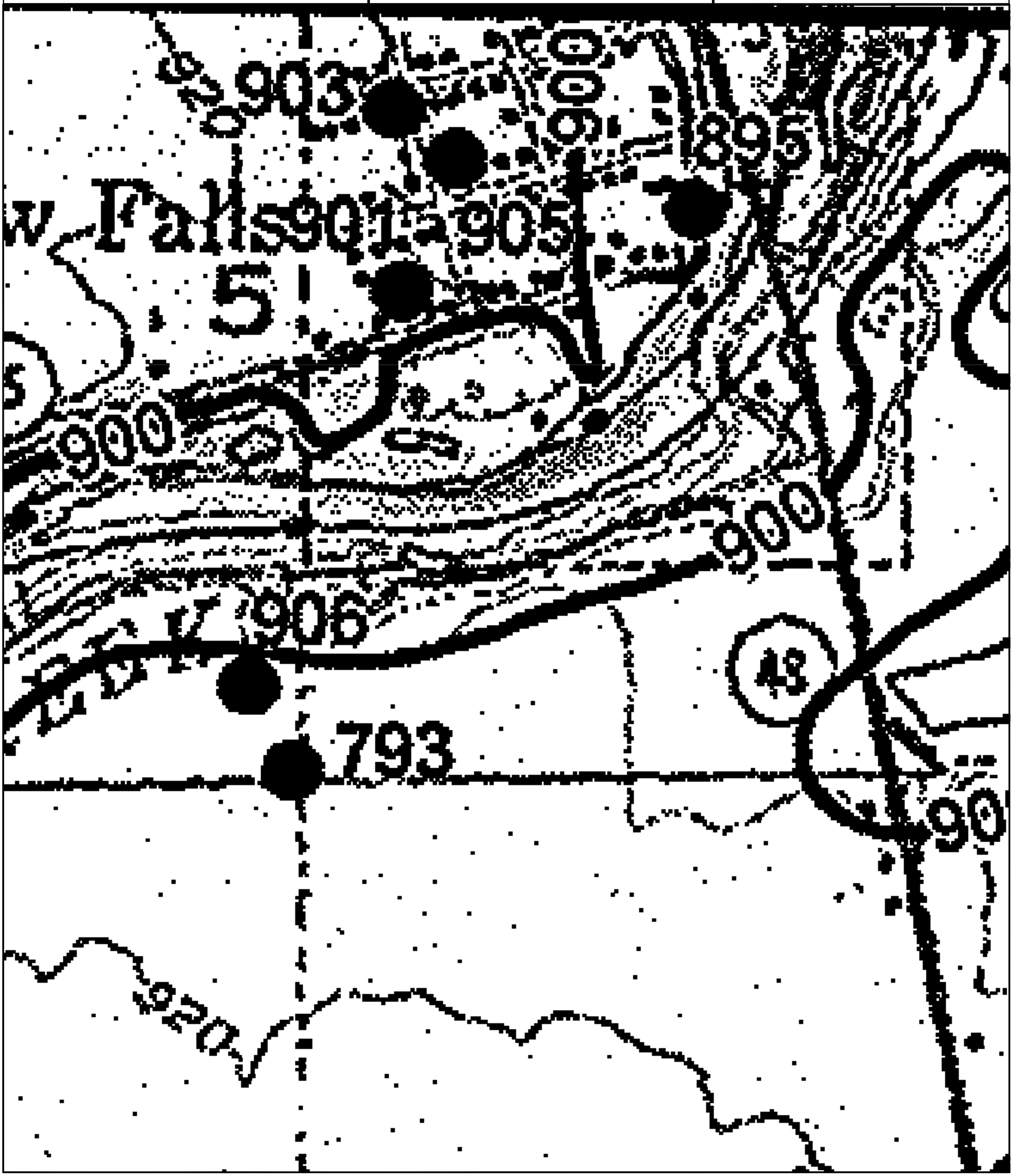
FIGURE 3-4: AREA BEDROCK-SOUTH

GRAPHIC SCALE

0 300 600

(IN FEET)

1 inch = 600 ft.



U.S. Fish and Wildlife Service
National Wetlands Inventory

Village of Ludlow Falls

Mar 4, 2015

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:

FIGURE 3–5: WETLANDS

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Ohio State Plane South Zone (FIPS zone 3402). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from digital orthophotography provided by the Ohio Statewide Imagery Program. This information was created from photography dated 2006.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

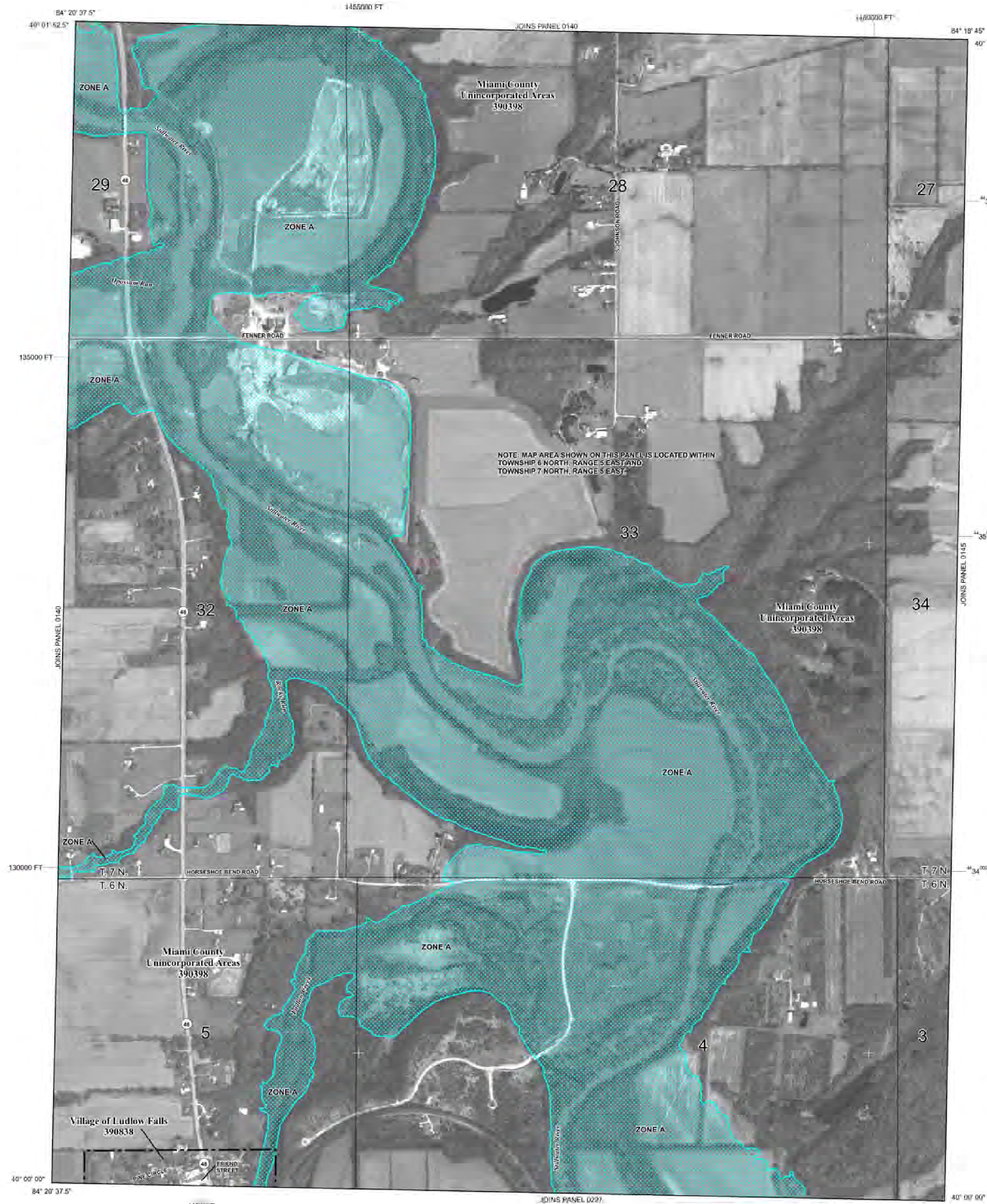
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center** (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange (FMIX) at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - 23	Transect line
	Culvert
	Bridge
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
3100000 FT	5000-foot ticks: Ohio State Plane South Zone (FIPS Zone 3402), Lambert Conformal Conic projection
$^{76}89^{000m}$ N	1000-meter Universal Transverse Mercator grid ticks, zone 16N
DX5510 X	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 2, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0139E

FIRM

FLOOD INSURANCE RATE MAP

MIAMI COUNTY,
OHIO
AND INCORPORATED AREAS

PANEL 139 OF 295

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LUDLOW FALLS, VILLAGE OF	390838	0139	E
MIAMI COUNTY	390398	0139	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
39109C0139E

EFFECTIVE DATE
AUGUST 2, 2011

Federal Emergency Management Agency

GRAPHIC SCALE

0 625 1250

(IN FEET)
1 inch = 1250 ft.

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ibigroup.com

REVISION:

SUBMISSION:

VILLAGE OF LUDLOW FALLS
MVRPC
UNSEWERED
COMMUNITIES

SHEET TITLE:

100 YEAR FLOOD
MAP - NORTH

Figure 3-6

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Ohio State Plane South Zone (FIPS zone 3402). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from digital orthophotography provided by the Ohio Statewide Imagery Program. This information was created from photography dated 2006

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

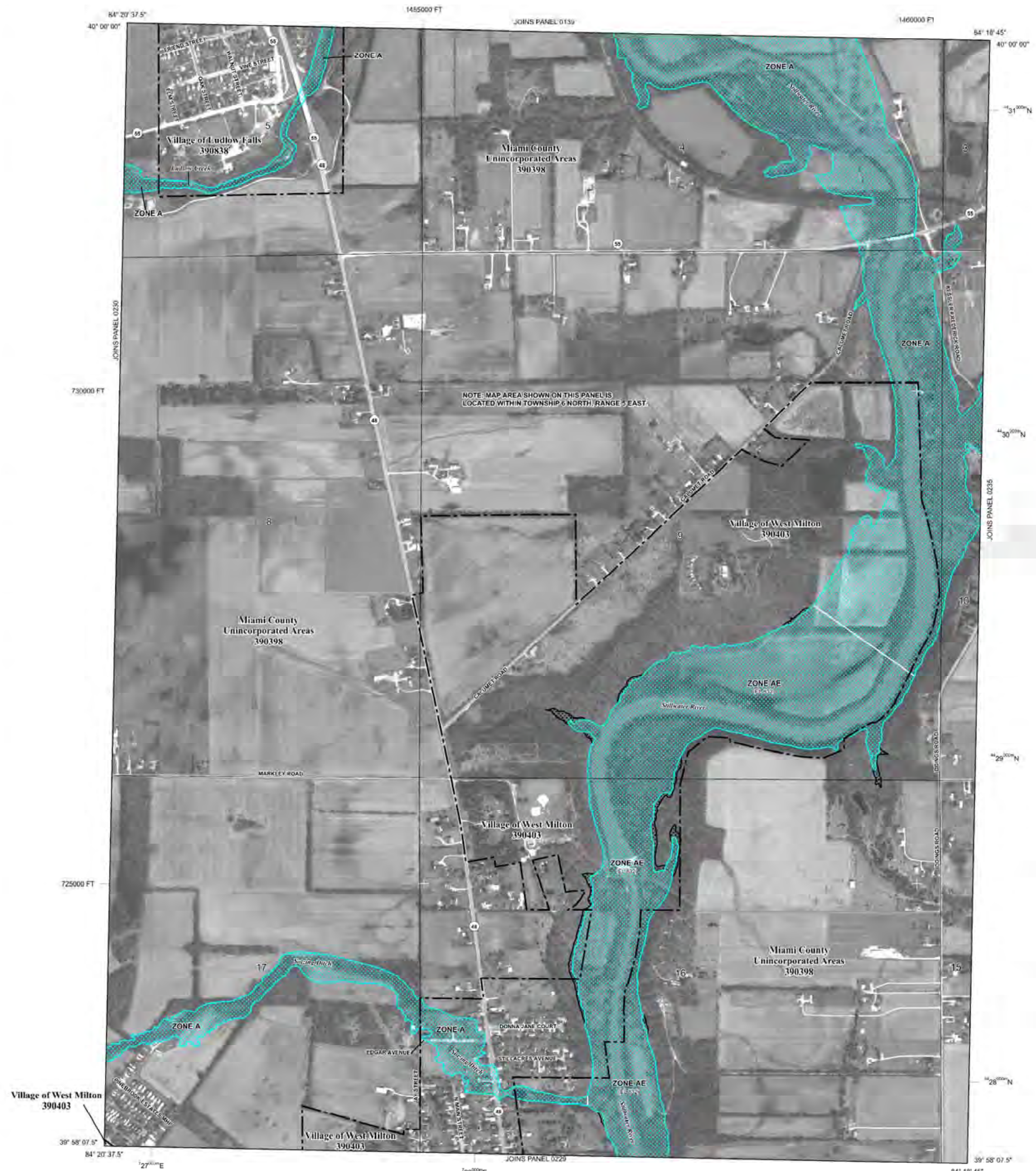
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center** (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange (FMIX) at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The Floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - 23	Transect line
	Culvert
	Bridge
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
3100000 FT	5000-foot ticks: Ohio State Plane South Zone (FIPS Zone 3402), Lambert Conformal Conic projection
4980000 N	1000-meter Universal Transverse Mercator grid ticks, zone 16N
DX5510 X	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 2, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0227E

FIRM
FLOOD INSURANCE RATE MAP
MIAMI COUNTY, OHIO
AND INCORPORATED AREAS

PANEL 227 OF 295
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LUDLOW FALLS, VILLAGE OF	390838	0227	E
MIAMI COUNTY	390398	0227	E
WEST MILTON, VILLAGE OF	390403	0227	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
39109C0227E

EFFECTIVE DATE
AUGUST 2, 2011

Federal Emergency Management Agency

GRAPHIC SCALE

0 625 1250

(IN FEET)
1 inch = 1250 ft.

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REVISION:

SUBMISSION:

VILLAGE OF LUDLOW FALLS
MVRPC
UNSEWERED
COMMUNITIES

SHEET TITLE:

100 YEAR FLOOD
MAP - SOUTH

Figure 3-7

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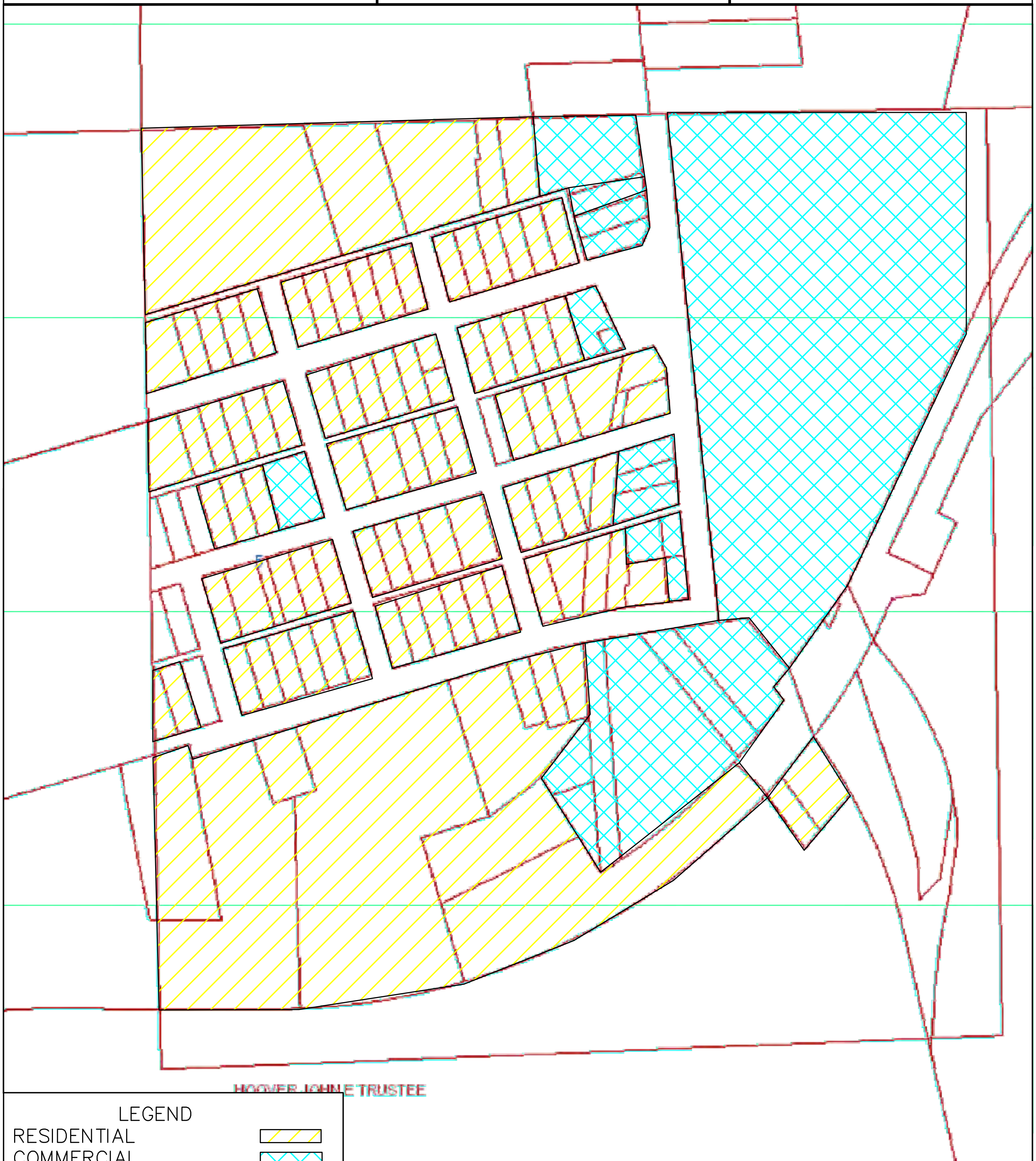
VILLAGE OF LUDLOW FALLS

MVRPC UNSEWERED COMMUNITIES

FIGURE 3-7: LAND USE MAP

GRAPHIC SCALE
0 150 300
(IN FEET)
1 inch = 300 ft.



LEGEND
RESIDENTIAL
COMMERCIAL
VACANT/AGRICULTURE

Chapter 4 - Future Conditions

A 25-year planning period will be used and all forecasts on population, land use, economics, flows, and loads will be trended from the most recent available data to the year 2040.

Development

Demographic and economic projections are vital to the planning of wastewater facilities in that they permit proper sizing of both collection and treatment systems. Over estimating these projections can result in oversized facilities which are not utilizing their maximum capacities. Under estimating these projections can result in an undersized facility, which would need expensive upgrades to reach the desired degree of treatment. As a result, a need for accurate projections cannot be overstressed.

There is a potential for residential and commercial growth just outside of the corporation limits of the Village. These possibilities need to be taken into consideration when designing a new wastewater system. The proposed system needs to be able to with stand the additional amount of collection needed.

Population Trends

The development of an area is directly related to changing population over time. In general, population growth trends create the basis for changing demand for various housing and commercial development. Population growth also has implications for demands on community facilities and infrastructure.

Determining population trends for smaller areas is more unreliable and erratic than for larger urban areas because small area growth is influenced by local political factors and social economic changes. Historically, the provision of adequate water and sewage facilities remains a major influence on future growth.

The following table shows the population of Miami County and the Village of Ludlow Falls between 1980 to 2010. While the population of the County continues to increase, the population of Ludlow Falls has seen a dramatic decrease between 1990 and 2000 and has steadied in 2010.

Table 4-1: Population Trends

Year	Miami County Population	% Change	Ludlow Falls Population	% Change
1980	90,381	-	248	-
1990	93,182	3.1%	235	-5.2%
2000	98,868	6.1%	210	-10.6%
2010	102,506	3.7%	208	-1.0%

To generate future population projections through the year 2050, it is assumed that the population of Ludlow Falls will continue to increase steadily. As mentioned earlier, there are 7 homes within Union Township that are not included in the Ludlow Falls population. These homes are multiplied by the U.S. Census average of 2.8 persons per home and combined with the Ludlow Falls population. From there, we have assumed the study area will grow at a geometric gradient of approximately 5 percent for every 10 years or 1/2 percent annually. This may appear conservative based on historical trends of the community, but the development of a public sewer system may spur more development in the area. Accommodating for any lot splits adding additional housing which cannot be done currently based on the current wastewater regulations.

The following table shows the projected population for the study area and a theoretical sanitary flow based on EPA's typical 100 gallons per capita per day.

Table 4-2: Projected Population

Year	Ludlow Falls Population	Union Twp Population	Combined	% Change	Sewage Flow (gpcd)	Total Theoretical Sanitary Flow (gpd)
2010	208	20	228	-	100	22,800
2020	218	21	239	4.8%	100	23,900
2030	229	22	251	5.0%	100	25,100
2040	240	23	263	4.8%	100	26,300
2050	252	24	276	4.9%	100	27,600

In addition to the residential design flows, the Missionary Camp can have up to approximately 30,000 GPD during the summer. Furthermore, an allowance for future industrial development should be made. 10% will be used for the service area.

Table 4-3: Design Flow

Year	Base Residential Sanitary Flow (gpd)	Commercial and Industrial Allowance (gpd)	Missionary Camp Flow (gpd)	Total Design Flow (gpd)
Present - 2040	26,300	3,000	30,000	59,300

We recommend that the proposed wastewater treatment facility be designed for a minimum of 60,000 GPD. This is higher than the current water consumption records as provided by West Milton in the previous section but accounts for future growth of the area.

Design peak flows for treatment will be based on 4.0 times the average daily flows. Therefore the peak flows will be 0.240 MGD (240,000 GPD).

Chapter 5 - Wastewater System Alternatives

The primary goal of all wastewater management systems is to remove waste products from water and to safely return the water back into the environment. Wastewater management involves:

- Collection and transport of wastewater from the source to a treatment process
- Removal of all or most of the waste products that are suspended and/or dissolved in the water
- Returning the water back to the environment
- Management of these processes to ensure that a wastewater system is fully functional

The primary public health concern in wastewater management is to substantially reduce the risk of transferring pathogens into the environment and minimize negative impacts on public health. The following sections describe different alternatives for each of these collection and treatment processes.

Collection System Alternatives

The first stage for managing wastewater is collection. Several alternatives were reviewed to provide a centralized collection system. These options are: Gravity Sewer system, Septic Tank Effluent Pump (STEP) sewer system, Grinder Pump Sewer system, and a Vacuum Sewer system.

Gravity Sewer System

Gravity sewers are ideal for populated urban areas that create large volumes of flow. In conventional gravity collection systems the wastewater flows by gravity and except where pumping stations are required, the system is devoid of moving parts. Pump stations are added to the gravity system to overcome elevation problems within areas of rolling terrain or to avoid extremely deep installation requirements when transporting sewage over long distances. The system eliminates private septic tanks and leeching systems and replaces them with a sewer pipe that connects the building to the main sewer line. Gravity sewer systems require little maintenance in comparison to pressure systems such as the STEP or leaching type systems. The primary O,M&R costs for this type of system are generally associated with the pump stations within the system. O,M&R demands generally increase with age, but in well constructed systems, costs associated with this can be minimal. Due to larger pipe diameters, blockages within the system are rare and are generally easily removed when they do occur. With the simplicity of design and many years of application, conventional gravity sewer systems are a reliable and economical means of conveying wastewater from multiple sources to a central treatment facility. The following is a list of advantages and disadvantages for a conventional gravity sewer system.

Advantages

- Design standards and procedures well established
- Reliable operation
- Handle grit and solids
- At minimum velocity lower production of hydrogen sulfide
- Higher excess capacity for future growth

Disadvantages

- Slope requirements can require deeper excavation
- Pumping and lift stations may be required to overcome slope and elevation requirements
- Deeper manholes that require confined space entry
- Higher inflow and infiltration
- High bedrock could increase construction cost

Conventional gravity sewers are generally 8 to 15 inches in diameter and constructed of polyvinyl chloride (PVC) pipe with construction depths ranging from 7 to 20 feet. All sewers are designed and constructed to develop velocities not less than 2.0 feet per second when flowing full. Also, manholes are installed at the end of each line, at all changes in grade and/or alignment, at all intersections, and at distances not greater than 400 feet (for sewer up to 15 inches in diameter).

Residential and non-residential flows along with allowable clean water infiltration quantities must be considered in the design of a gravity wastewater collection system. Infiltration is identified as clean ground water that seeps into a sanitary collection system through pipe joints and other minor openings and mixes with sanitary flows creating larger volumes of wastewater to transport and treat. The allowable infiltration rate limit of 100 gpd per inch diameter per mile is based on current sanitary sewer construction technology. However, this amount would be expected to increase over the years mainly due to sewer extensions and the age of the collection system. Conventional gravity sewers shall also be designed on a peak flow basis with a peak factor of 3.33 times the average daily flow for municipalities as required by the EPA.

The minimum size of new conventional sanitary sewers is generally eight inches unless otherwise approved by the reviewing authority. Whenever possible, sanitary sewers shall be sufficiently deep to prevent freezing and to receive gravity flow from basements. Alternatives to the conventional gravity sewer system involve using grinder pump stations or septic systems. These are used to provide service to areas where the cost or the means of constructing a gravity system becomes dangerous or prohibitive.

Generation of the gravity collection system assumes that service laterals would be constructed from the main sewer line (usually located within public right-of-way) to the property lines (assumed 30 feet). From the property line to the house connection, individual property owners are typically required to construct the service line as well as abandon the existing septic tank or other on-lot disposal system. Figure 5-1 shows the standard house connection for a gravity collection system. Figure 5-2 illustrates the layout of the gravity sewer system.

A Gravity Collection System works well in the Village of Ludlow Falls given the general slope down from west to east. Gravity sewers can be placed in alleyways behind the homes with the least impact to established streets. Three homes located along Ludlow Creek on the south side of the service area will require Grinder pumps to keep sewer depths reasonable. The deepest sewer as shown is approximately 16 feet deep with an average of 13 feet deep.

A detailed construction cost analysis of this system is presented below in Table 5-1.

Table 5-1: Gravity Sewer Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	CLEARING & GRUBBING	1	LS	$5,000	$5,000
2	TEMPORARY SOIL EROSION CONTROL	1	LS	$5,000	$5,000
3	ASPHALT PAVEMENT REMOVAL & REPLACEMENT, COMPLETE	2,800	SY	$30	$84,000
4	8" GRAVITY SEWER PIPE, COMPLETE W/ BEDDING & BACKFILL	6,030	LF	$80	$482,400
5	6" SANITARY SERVICE PIPE, COMPLETE W/ BEDDING & BACKFILL	2,600	LF	$45	$117,000
6	8X6 WYE FITTING, COMPLETE	90	EA	$150	$13,500
7	3" SANITARY FORCE MAIN, COMPLETE W/ BEDDDING & BACKFILL	850	LF	$20	$17,000
8	ROCK EXCAVATION	7,000	CY	$40	$280,000
9	MANHOLE, COMPLETE	19	EA	$3,200	$60,800
10	GRINDER PUMP, COMPLETE	3	EA	$3,000	$9,000
11	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
12	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
13	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
14	SEEDING & MULCHING, COMPLETE	4,000	SY	$1	$4,000
15	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$1,132,700
10% CONTINGENCY					$113,270
20% NON-CONSTRUCTION					$226,540
TOTAL					**$1,472,510**

STEP Sewer System

A Septic Tank Effluent Pump (STEP) collection system combines the traditional septic tank system with a small pump and force main or a small diameter gravity system. The STEP system collects only the effluent off of septic tanks which can be located at each customer's building or a group of customers can be on one septic tank. The STEP system then uses small effluent pumps and a network of force mains, usually 2 inch to 4 inch pipe, to collect the effluent and send it to a small package treatment plant.

This collection system conducts different stages of treatment at different locations. The solids are collected in a septic tank, where primary treatment takes place, before the sewage is discharged into a central collection system. Wastewater then flows from the pressurized collection system to a small package plant where the effluent is treated and disinfected. The following is a list of advantages and disadvantages for the STEP system.

Advantages

- Connect multiple residents to septic tank
- Infiltration reduced
- Cleanouts and valve assemblies less expensive than manholes.
- Pipe size and depth requirements reduced

Disadvantages

- Mechanical components require greater institutional involvement
- O,M&R costs higher due to number of septic tanks and pumps
- Annual preventative maintenance for septic tanks and pumps
- Life cycle replacement costs are higher
- Power outages can result in limited use for pumps
- Required solids removal as part of septic tank maintenance

Advantages of a STEP system over a conventional gravity system are smaller pipe sizes and shallower pipe depths within the collection network. Smaller pipes have lower material costs and may be less expensive to install.

The STEP network uses all force mains and the depth of the pipes will be shallower than a conventional gravity system, thus further reducing the installation costs. On the other hand, the septic tanks and effluent pumps can drive up the initial cost of installation. The effluent pumps will need regular maintenance and repairs, and the septic tanks will require regular cleaning to remove the solids collected within them. Thus, the O,M&R cost of the system will go up as well.

A STEP system can be an effective means of collecting sewage from a small collection of homes, subdivisions, schools, and industrial parks, but it is not usually the preferred means of treatment for large communities or facilities that generate large flows. Ludlow Falls would be considered a small system.

The connection at the house will be similar to Figure 5-3. This Figure shows the typical connection for a STEP system where either the existing or new septic tank is installed on the property with an effluent pump where it is transported to the pressure main through a 1 ½ " pressure service line. Figure 5-5 shows the layout for the STEP collection system.

A detailed construction cost analysis of this system is presented below in Table 5-2.

Table 5-2: STEP Sewer Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	1,000 GAL SEPTIC TANK W/ PUMP	86	EA	$5,700	$490,200
2	1,500 GAL SEPTIC TANK W/ PUMP	4	EA	$6,500	$26,000
3	2" DIA. FORCEMAIN	2,960	LF	$30	$88,800
4	3" DIA. FORCEMAIN	3,070	LF	$35	$107,450
5	AIR RELEASE VALVES	3	EA	$2,500	$7,500
6	CLEANOUTS	6	EA	$950	$5,700
7	1.25" DIA. SERV LAT & CONNECTION	90	EA	$1,200	$108,000
8	SEEDING & MULCHING	2,140	SY	$1	$2,140
9	ASPHALT PAVEMENT REPLACEMENT	2,496	SY	$30	$74,880
10	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
11	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
12	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
13	CLEARING & GRUBBING	1	LS	$5,000	$5,000
14	TEMPORARY SOIL EROSION CONTROL	1	LS	$5,000	$5,000
15	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$975,670
10% CONTINGENCY					$97,567
20% NON-CONSTRUCTION					$195,134
TOTAL					**$1,268,371**

Grinder Pump Sewer System

The Grinder pump system utilizes a prefabricated pump and basin configuration. Wastewater from the house flows into the grinder pump station basin until liquid level controls turn on the pump. The grinder pump simultaneously grinds the waste into a slurry while pumping into the collection mains. Individual services are usually 1 ¼“ PVC pipe with collection mains usually 2” to 6” PVC pipe.

The layout for the typical grinder system here is similar to those generated for the STEP system in this report. A low-pressure force main sewer system will follow the existing topography with the addition of isolation valves at intersections of mains, in-line cleanouts, terminal cleanouts, air release valves, and pressure monitoring stations. Main sewer lines would be constructed ranging in size from 4 inches to 6 inches in diameter. The following is a list of advantages and disadvantages for a conventional grinder pump sewer system.

Advantages

- Slope and pipe alignment not as critical as gravity sewers
- Pipe size and depth requirements reduced
- Cleanouts and valve assembles less expensive than manholes

Disadvantages

- Less- flexibility for expansion, O,M&R concerns
- Less range of flow capacity
- Power outages can result in limited use for pumps
- Periodic maintenance

Another operating concern with low pressure systems is power outage. A typical power outage lasts less than two hours. Grinder pump basins are designed with several hours' worth of holding capacity. However, in power outage conditions individuals would need to avoid showers and other heavy water usage activities.

The Grinder Pump conventional sewer connection and collection layout would be very similar to that of the STEP system with the exception that the existing septic tank would be removed and a grinder pump would replace the effluent pump, thus eliminating the primary treatment component associated with a STEP system. The design for each of these can be seen in Figures 5-4 and 5-5.

A detailed construction cost analysis of this system is presented below in Table 5-3.

Table 5-3: Grinder Pump Sewer Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	SIMPLEX GRINDER PUMP UNITS	90	EA	$6,200	$558,000
2	2" DIA. FORCEMAIN	2,645	LF	$30	$79,350
3	3" DIA. FORCEMAIN	3,773	LF	$35	$132,055
4	AIR RELEASE VALVES	3	EA	$2,500	$7,500
5	CLEANOUTS	6	EA	$950	$5,700
6	1.25" DIA. SERV LAT & CONNECTION	90	EA	$1,200	$108,000
7	SEEDING AND MULCHING	2,140	SY	$1	$2,140
8	ASPHALT PAVEMENT REPLACEMENT	2,496	SY	$30	$74,880
9	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
10	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
11	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
12	CLEARING & GRUBBING	1	LS	$5,000	$5,000
13	TEMPORARY SOIL EROSION CONTROL	1	LS	$5,000	$5,000
14	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$1,032,625
10% CONTINGENCY					$103,263
20% NON-CONSTRUCTION					$206,525
TOTAL					**$1,342,413**

Vacuum Sewer System

Vacuum sewer systems are a mechanized system of wastewater transport where, unlike gravity flow, differential air pressure is used to move the wastewater. It requires a central source of power to run vacuum pumps which maintain a vacuum on the collection system. The system requires a normally closed vacuum/gravity interface valve at each entry point to seal the lines so that vacuum is maintained. These valves, located in a pit, open when a predetermined amount of wastewater accumulates in the collecting sump. The resulting differential pressure between atmosphere and vacuum becomes the driving force that propels the wastewater towards the vacuum station. A vacuum system is similar to a rural water distribution system in that it is a dendriform shape. The following is a list of advantages and disadvantages of a vacuum sewer system.

Advantages

- Installed following the existing topography
- Pipe size and depth requirements reduced

Disadvantages

- Less- flexibility for expansion, O,M&R concerns
- A broken main line can cause substantial operating problems
- Few vacuum sewer systems are in use

The layout for the typical Vacuum Sewer system here, again, is similar to those generated for the Gravity collection system in this report. A Vacuum Sewer system will follow the existing topography with the addition of vacuum valves, auxiliary vents, valve pits/sump pits, vacuum stations, and lift stations. Main sewer lines would be constructed ranging in size from 4 inches to 6 inches in diameter.

The connection at the house will be similar to Figure 5-6. This Figure shows the typical connection for a Vacuum system where the existing septic tank is abandoned and wastewater from the home flows by gravity to a valve pit, which is then transported to the main via 3 inch vacuum service line. A potential layout of the vacuum collection system can be found in Figure 5-7.

A detailed construction cost analysis of this system is presented below in Table 5-4.

Table 5-4: Vacuum Sewer System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	6.0' - 2PC HYBRID VALVE PIT	90	EA	$4,700	$423,000
2	AIR TERMINALS	90	EA	$230	$20,700
3	TRAILER MOUNTED VACUUM PUMP	1	EA	$40,000	$40,000
4	PACVAC 165M-10	1	LS	$250,000	$250,000
5	3" SERVICE LATERAL, COMPLETE	6,030	LF	$25	$150,750
6	3" ISOLATION VALVE, COMPLETE	6	EA	$1,200	$7,200
7	VAC STA - SITE WORK	1	LS	$20,000	$20,000
8	VAC STA - BUILDING/FOUNDATION	1	LS	$10,000	$10,000
9	VAC STA - TANK INSTALLATION	1	LS	$20,000	$20,000
10	VAC STA - MECHANICAL/ELECTRICAL (BLDG TO TANK)	1	LS	$15,000	$15,000
11	VAC STA - VALVE VAULT(S)	1	LS	$5,000	$5,000
12	VAC STA - ODOR CONTROL	1	LS	$15,000	$15,000
13	VAC STA - GENERATOR	1	LS	$35,000	$35,000
14	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
15	CLEARING AND GRUBBING	1	LS	$5,000	$5,000
16	TEPMORARY SOIL CONTROL	1	LS	$5,000	$5,000
17	MAINTAINING TRAFFIC	1	LS	$15,000	$15,000
18	CONSTRUCTION LAYOUT STAKING	1	LS	$20,000	$20,000
19	SEEDING AND MULCHING	2,139	SY	$1	$2,139
20	ASPHALT PAVEMENT REMOVAL & REPLACEMENT, COMPLETE	2,496	SY	$30	$74,880
21	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$1,168,669
10% CONTINGENCY					$116,867
20% NON-COSTRUCTION					$257,107
TOTAL					**$1,542,643**

Treatment System Alternatives

The treatment of wastewater is the second stage in managing wastewater. Four scenarios were reviewed for the Village of Ludlow Falls. Three scenarios include the construction of a new wastewater treatment facility in Ludlow Falls. These treatment options include an extended aeration plant, a lagoon system or a packed bed media system. One additional scenario includes transporting wastewater to the Village of West Milton's existing treatment facility and contracting with West Milton for treatment operations.

Given that the proposed wastewater treatment facilities are new, there are currently no specific effluent parameters for the Ludlow Falls area. Without having specific effluent limitation parameters, effluent will need to comply with the EPA's Best Available

Demonstrated Control Technology for new sources discharging sanitary wastewater which is identified as follows:

Table 5-5: Design Effluent

Parameter	30 Day Limit	Daily or 7 Day Limit	Max/Min Limit
CBOD5	10 mg/l	15 mg/l	n/a
Total Suspended Solids	12 mg/l	18 mg/l	n/a
Ammonia (summer)	1.0 mg/l	1.5 mg/l	n/a
Ammonia (winter)	3.0 mg/l	4.5 mg/l	n/a
Dissolved Oxygen	n/a	n/a	6.0 mg/l (min.)
Total Residual Chlorine	n/a	n/a	0.038 mg/l (max.)
E. Coli	126 / 100 ml	235 / 100 ml	n/a

In addition, a final decision upon the amount of residual treated wastewater constituents requires a formal study of the receiving water, in this case Ludlow Creek.

For the purpose of this study, it will be assumed that any new wastewater treatment facility will consist of primary, secondary and tertiary treatment. In the three scenarios evaluated, the extent of each component i.e. primary, secondary and tertiary treatment will be described briefly and used to evaluate the alternatives.

New Wastewater Treatment Plant – Extended Aeration

The first alternative for a new wastewater treatment plant utilizes extended aeration. Extended Aeration is a modified form of the activated sludge treatment process and is ideal for smaller flows. For purpose of this study, it will be assumed that the proposed treatment facility would consist of mechanical screening and grit removal as primary treatment. Secondary treatment would be the extended aeration process and clarification. This would be followed by tertiary filtration, Ultra Violet (UV) disinfection, post aeration and sludge treatment for land application.

Treatment of the wastewater will begin with the removal of large pieces of debris and any materials carried through the collection system using a bar screen followed by a mechanical fine screen. The bar screen will need to be manually cleaned by an operator. Mechanical fine screens typically have an automated self cleaning system. The screenings will be collected and disposed of appropriately.

Following the screening process the wastewater will then proceed to secondary treatment which in this alternative is the extended aeration process. The proposed Biolac System is an activated sludge biological treatment system that is suitable for many municipal wastewater applications. It is an extended aeration system with internal final clarification. The system utilizes low-loaded activated sludge technology, single basin operation, simple basin construction, and high-efficiency aeration chains with suspended fine –bubble diffusers. These features make the system very effective and cost efficient. The treatment process is presented in the diagram in Figure 5-8.

The system also offers a longer activated sludge age than most treatment systems. This provides excellent BOD removal, complete nitrification, and nutrient removal in warm and cold climates. The process incorporates a wave-oxidation process, which simplifies biological nutrient removal. Air distribution can be adjusted to vary the dissolved oxygen content and promotes alkalinity recovery. It also promotes nitrification, denitrification, and biological phosphorous removal.

Clarification is the next step in the treatment process and this occurs in a chamber that is integral to the extended aeration basin. The clarified wastewater then proceeds to the rapid sand filters where the tertiary filtration occurs. The rapid sand filters will be utilized as a polishing step to improve the quality of the wastewater prior to discharge.

After tertiary filtration, the wastewater is then disinfected as it proceeds through the UV disinfection unit. This is the followed by post aeration to meet the dissolved oxygen requirements. The treated effluent is then discharged to the receiving stream i.e. Ludlow Creek.

Sludge that is collected at the bottom of the clarifier flows to a sludge holding tank. From the sludge holding tank, some of the sludge can be pumped and returned to be mixed with the influent. This can be either upstream of the screening process or combined with the influent to the aeration basin. Any remaining sludge in the sludge holding tank can be held for extended periods of time without aeration. Air can be easily introduced into the sludge if required via the diffused air piping in the sludge holding tank. No further digestion is required and the large quantity of biomass can treat fluctuating loads with minimal operational changes. It also minimizes excess sludge and makes the process very stable. Excess sludge can be pumped to sludge drying beds for dewatering and further processing prior to land application.

A building will also be provided for the blowers, electrical equipment, process controls and other appurtenances necessary for the operation of the plant. A sludge building will also be considered for sludge processing equipment as required.

Advantages

- Modular – ready for installation
- Routinely maintains good effluent quality
- Highest capacity to accept increased wastewater flows
- Relatively odorless and noiseless operation
- Less indicative to site selection

Disadvantages

- Increased power consumption
- Increased O,M&R
- More frequent sludge handling

Under this scenario, the Village of Ludlow Falls would construct, own, operate, and maintain a wastewater treatment plant which would be designed to handle wastewater flows of 65,000 GPD. The location of the wastewater treatment plant would be in the southern end of the Village along Ludlow Creek.

Listed below in Table 5-6 is a construction cost estimate for an extended aeration plant.

Table 5-6: Extended Aeration Treatment System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	BARS/SCREEN UNIT	1	LS	$ 50,000	$ 50,000
2	BIOLAC SYSTEM	1	LS	$ 250,000	$ 250,000
3	SAND FILTER	1	LS	$ 30,000	$ 30,000
4	SLUDGE DRYING BED	1	LS	$ 40,000	$ 40,000
5	SLUDGE BUILDING	1	LS	$ 40,000	$ 40,000
6	UV DISINFECTION UNIT	1	LS	$ 40,000	$ 40,000
7	POST AERATION TANK/FLOW METERS	1	LS	$ 30,000	$ 30,000
8	OFFICE/BLOWERS BUILDING	1	LS	$ 100,000	$ 100,000
9	YARD PIPING	1	LS	$ 40,000	$ 40,000
10	SITE WORK	1	LS	$ 40,000	$ 40,000
11	ELECTRICAL AND CONTROL	1	LS	$ 35,000	$ 35,000
12	6" SANITARY FORCE MAIN, COMPLETE	500	LF	$ 24	$ 12,000
13	LAND ACQUISITION	2	AC	$ 10,000	$ 20,000
SUBTOTAL					$ 727,000
10% CONTINGENCY					$ 72,700
20% NON-CONSTRUCTION					$ 159,940
TOTAL					**$ 959,640**

New wastewater treatment plant - Facultative Lagoon System

The second alternative for the new wastewater treatment plant for the Village of Ludlow Falls considered in this study is a facultative lagoon system. The primary treatment for wastewater in this case is also screening. This will help to minimize floatables that could potentially accumulate in the lagoon.

A lagoon is a passive method of providing treatment by retaining wastewater for many months allowing microbes to break down the waste. In this process, sludge will be produced as a by-product which settles to the bottom until dredged.

Lagoons are used for residential, small commercial and small community applications that have suitable, available land. Lagoons provide treatment at a slow rate. Large volume and slow treatment are tradeoffs for little to no external energy requirements. Lagoons provide treatment through physical and biological processes.

Two types of lagoon systems commonly used for small communities include flow-through and controlled discharge lagoons which is dependent upon the stream size and characteristics for discharge. Flow-through systems require larger streams to minimize impact to the water quality. In this case, large streams are not immediately available, thus a controlled discharge lagoon would be considered.

In cold climates, lagoons which treat strong wastewater may require aerated lagoon systems. In an aerated lagoon, oxygen is supplied by means of surface aerators or diffused air units. The turbulence in a basin created by aeration keeps solids in suspension and aids in microbial growth to break down components in the wastewater. In this case, since wastewater is primarily residential, aeration will not be considered a necessary design addition.

Lagoon type systems are one of the most commonly used type system for small communities. The advantages of this type of system are the low O,M&R cost and minimum maintenance requirements. However, this type of system requires a large area for construction and treatment parameters of the effluent can't be controlled by operational means, which might require construction of additional treatment units.

Ten States Standards requires construction of three lagoons as a minimum and retaining the average daily flow for 180 days using an average depth of 4 feet in the ponds because of sludge accumulation. With an average daily flow of 60,000 GPD, a surface area of 8.98 acres would be needed to meet the storage requirements. In order to construct dikes to contain the water surface, an additional 80% of the water surface land size is needed. Thus site requirements would approach 17 acres (1.8 x 8.98 = 16.2 acres). Making this treatment option unlikely.

Advantages
- Easy to operate
- Requires little energy
- Smaller quantity of removed material

Disadvantages
- Difficult to control or predict ammonia levels
- Require large areas of land
- Burrowing animals

Listed below in Table 5-7 is a construction cost estimate for a lagoon treatment system.

Table 5-7: Lagoon Treatment System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	EXCAVATION & EMBANKMENT	1	LS	$ 300,000	$ 300,000
2	PROCESS PIPING	1	LS	$30,000	$30,000
3	CONTROLS	1	LS	$40,000	$40,000
4	INFLUENT CHAMBERS	1	LS	$30,000	$30,000
5	OUTFALL STRUCTURE	1	LS	$50,000	$50,000
6	SITE WORK	1	LS	$45,000	$45,000
7	GROUNDWATER CONTROL	1	LS	$40,000	$40,000
8	LAND ACQUISITION	22	AC	$10,000	$220,000
9	6" SANITARY FORCE MAIN, COMPLETE	500	LF	$24	$12,000
SUBTOTAL					$ 767,000
10% CONTINGENCY					$ 76,700
20% NON-CONSTRUCTION					$ 168,740
TOTAL					**$ 1,012,440**

New wastewater treatment plant - Packed Bed Media

Packed bed media filters are a secondary treatment option and designed to follow primary treatment, as achieved in the STEP collection system. If a different collection system is utilized then some other primary treatment process will have to be provided. Some of the media options for the packed bed media filter are sand/gravel, peat, foam, and textile (AdvanTex). The textile filter operates in the recirculating mode, similar to a recirculating sand or gravel filter and is the proposed media for this alternative.

Wastewater first enters an anoxic tank and then is applied over the top of the filter in small, uniform doses several times per hour. This process provides maximum holding time for the water within the fabric. Effluent is then collected at the bottom of the filter and returns to the Recirculation /Dilution (R/D) tank. The effluent is typically recirculated four times before being discharged. A diagram of the packed bed media process can be found in Figure 5-9.

Periodic maintenance by a trained service provider is critical to maintaining high quality effluent from the filter. If the biomat builds on top of the textile configuration, it will need to be periodically removed. The land size requirement for a packed bed media filter is smaller than most treatment systems. The land size requirement for this project would approximately be 1 acre.

Disinfection in this alternative will be achieved using UV disinfection and the treated effluent can be discharged.

A building will be provided for the electrical components, process controls and appurtenances as required.

Advantages

- Limited operator involvement
- Low power costs
- Able to handle seasonal or increasing flows
- Easy to expand

Disadvantages

- Needs Primary Treatment First
- Occurrence of clogging
- Media requires cleaning

Listed below in Table 5-8 is a construction cost estimate for a packed bed media treatment system.

Table 5-8: Packed Bed Media Treatment System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	42 ft AX-MAX	8	EA	$ 75,000	$600,000
2	14 ft PUMP BASIN	2	EA	$ 30,000	$60,000
3	RNE PUMP	1	EA	$ 600	$ 600
4	DUPLEX PUMPING PACKAGE	6	EA	$ 2,000	$12,000
5	35 ft AX-MAX	3	EA	$ 65,000	$195,000
6	PRE-ANOXIC TANK	1	EA	$ 50,000	$50,000
7	DISCHARGE PUMPING PACKAGE	1	LS	$ 2,000	$ 2,000
8	ALKALINITY WATER FEED PUMP	1	EA	$ 600	$ 600
9	ALKALINITY FEED SYSTEM	1	LS	$ 12,000	$12,000
10	INSTRUMENTATION/ FLOW METER	1	EA	$ 10,000	$10,000
11	FLOW EQUALIZATION TANK PUMPING EQUP.	1	LS	$ 5,000	$5,000
12	DISINFECTION (UV)	1	EA	$ 50,000	$50,000
13	CONTROLS BUILDING	1	EA	$ 50,000	$50,000
14	TELEMETRY CONTROL PANEL	7	EA	$ 8,000	$56,000
15	LAND ACQUISION	2	AC	$ 10,000	$20,000
SUBTOTAL					$1,123,200
10% CONTINGENCY					$112,320
20% NON-CONSTRUCTION					$247,104
TOTAL					**$1,482,624**

Regionalize with Adjacent Community - Transport Wastewater to West Milton

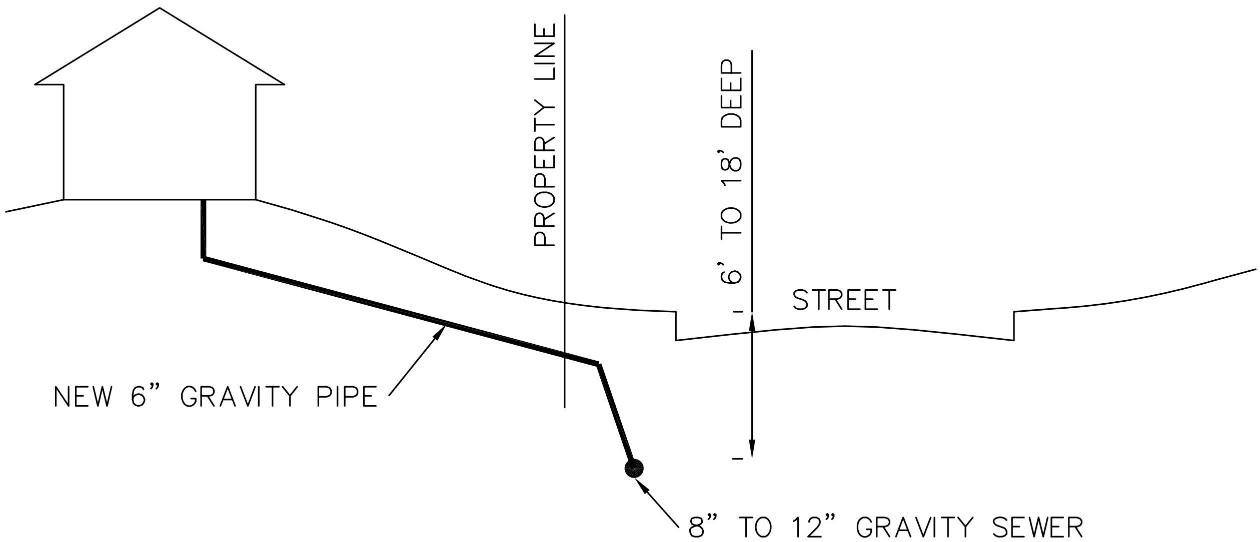
Another treatment option is to have a pump station transport the wastewater through a force main from the Village of Ludlow Falls to the Village of West Milton's collection system an ultimately their WWTP. The proposed force main would travel along State Route 48. The Village of West Miltons's WWTP is approximately 3.5 miles away located on the east side of the Village. Figure 5-10 illustrates the path of the force main from Ludlow Falls to West Milton. The design capacity for the West Milton WWTP is 1.2 MGD. The Village of West Milton has shown much interest in receiving the wastewater from Ludlow Falls, the church camp, and an adjacent potential 300 acre development. The development is located on the opposite side of Ludlow Creek which is planned for a possible campground. As such, they may consider paying for the pump station force main from Ludlow Falls to West Milton in order to receive the wastewater from the Village.

Listed below in Table 5-9 is a construction cost estimate for transporting wastewater to West Milton.

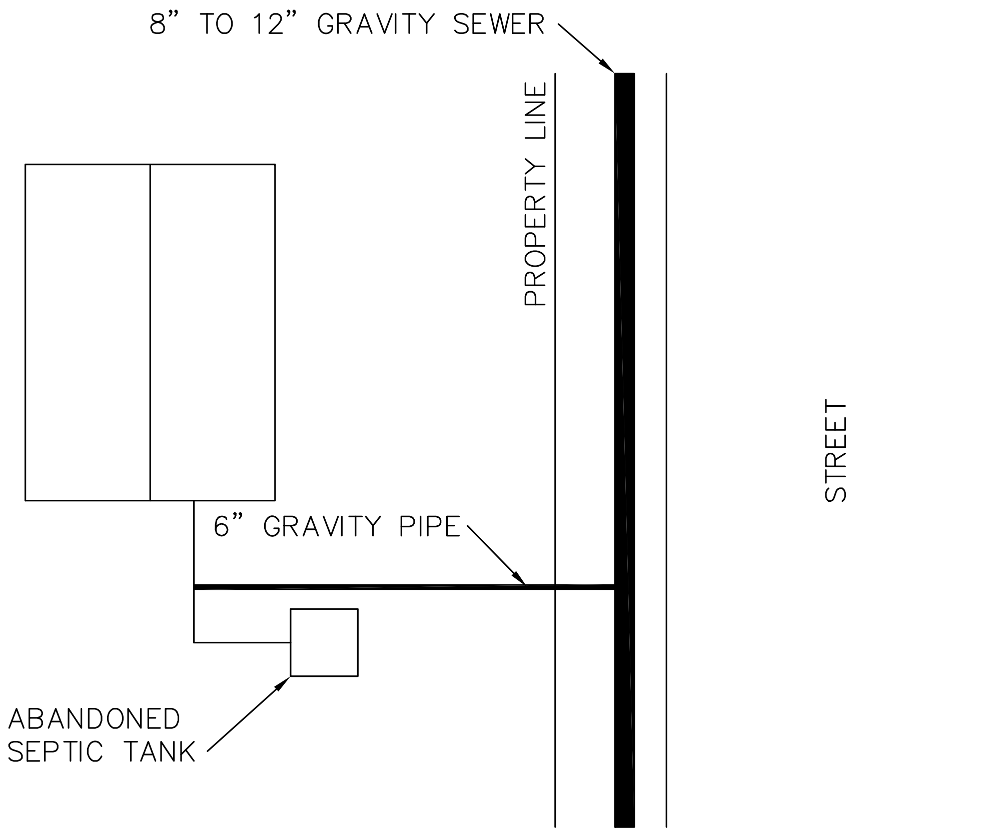
Table 5-9: Transport to West Milton Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	6" SANITARY FORCE MAIN, COMPLETE	11,000	LF	$26	$286,000
2	STREAM CROSSING	200	LF	$200	$40,000
3	PUMP STATION, COMPLETE	1	LS	$200,000	$200,000
4	AIR RELEASE MANHOLE AND VALVE	2	EA	$6,000	$12,000
5	PAVEMENT REMOVAL & REPLACEMENT	2,700	SY	$30	$81,000
6	SEEDING & MULCHING, COMPLETE	12,000	SY	$1	$12,000
7	MAINTENANCE & PROTECTION OF TRAFFIC	1	LS	$10,000	$10,000
SUBTOTAL					$641,000
10% CONTONGENCY					$64,100
20% NON-CONSTRUCTION					$141,020
TOTAL					**$846,120**

IBI GROUP 635 Brooksedge Boulevard Westerville OH 43081 USA tel 614 818 4900 fax 614 818 4901 **ibigroup.com**	VILLAGE OF LUDLOW FALLS MVRPC UNSEWERED COMMUNITIES	CONVENTIONAL GRAVITY SEWER CONNECTION FIGURE 5-1



SECTION (TYP.)



PLAN VIEW (TYP.)

GRAPHIC SCALE

0 150 300

(IN FEET)

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COMMUNITIES

SHEET TITLE:

GRAVITY SEWER
LAYOUT

FIGURE 5-2

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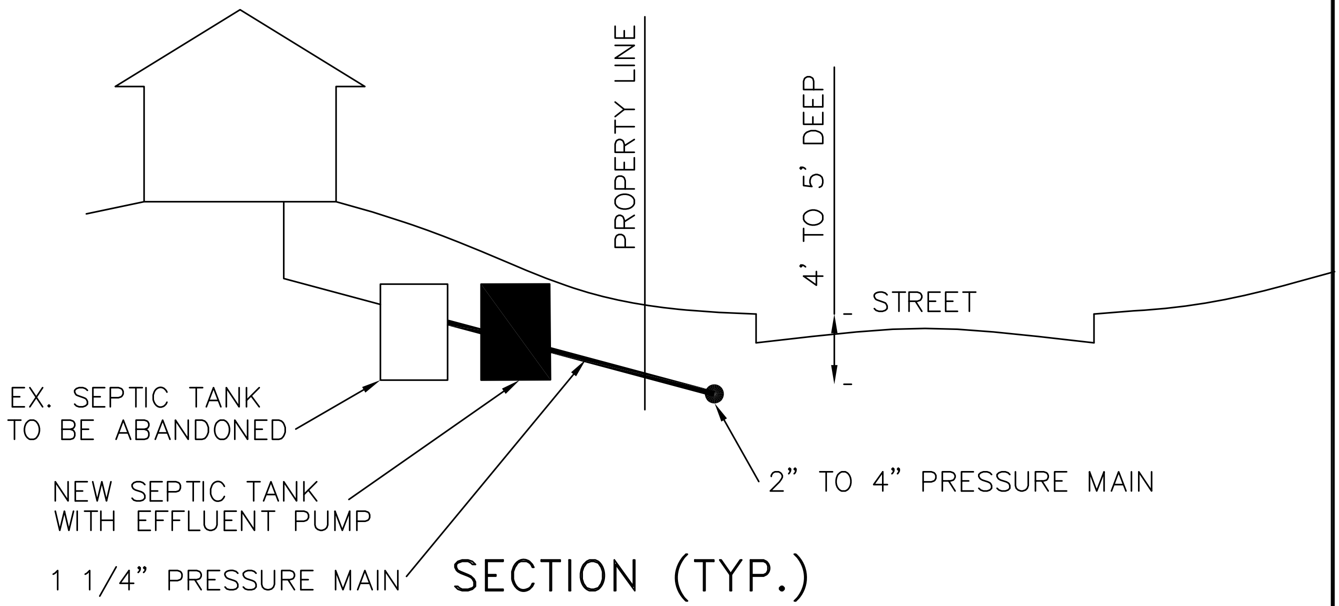
VILLAGE OF LUDLOW FALLS

MVRPC UNSEWERED COMMUNITIES

CONVENTIONAL STEP SEWER CONNECTION
FIGURE 5-3



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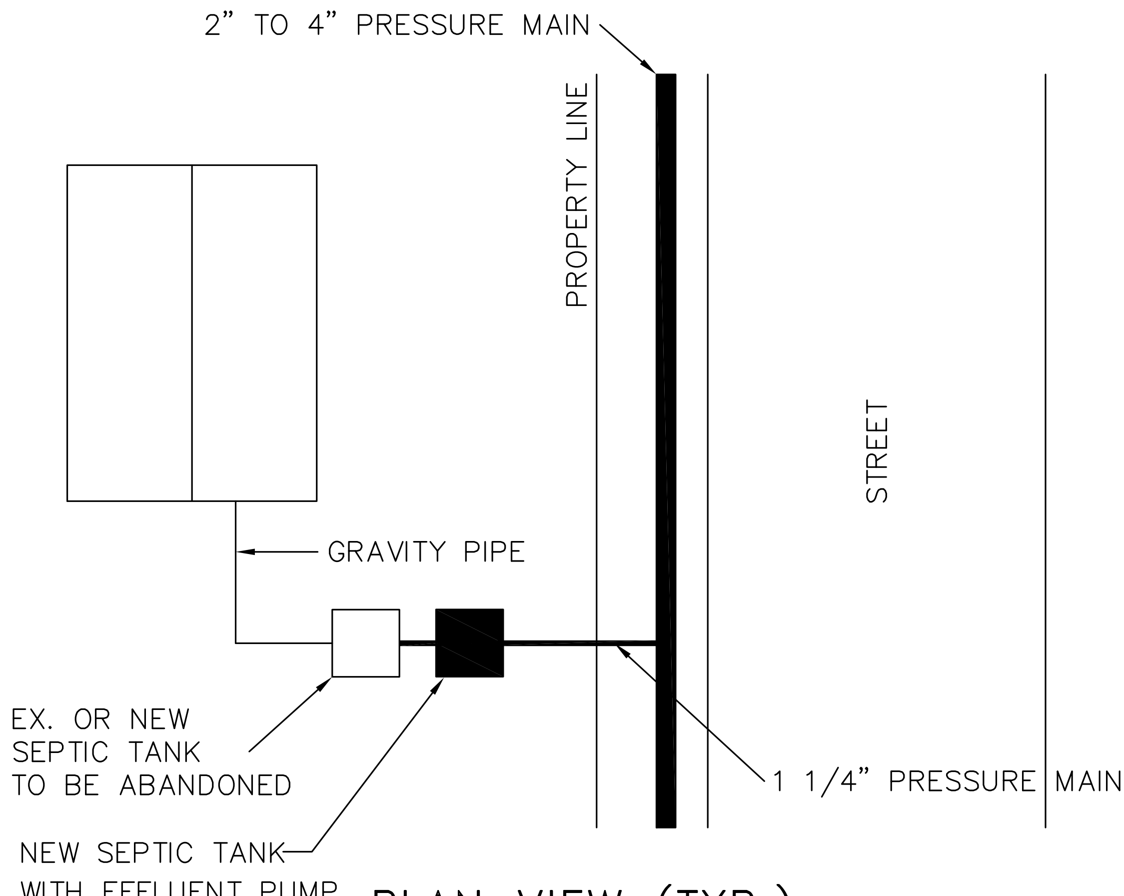

PLAN VIEW (TYP.)

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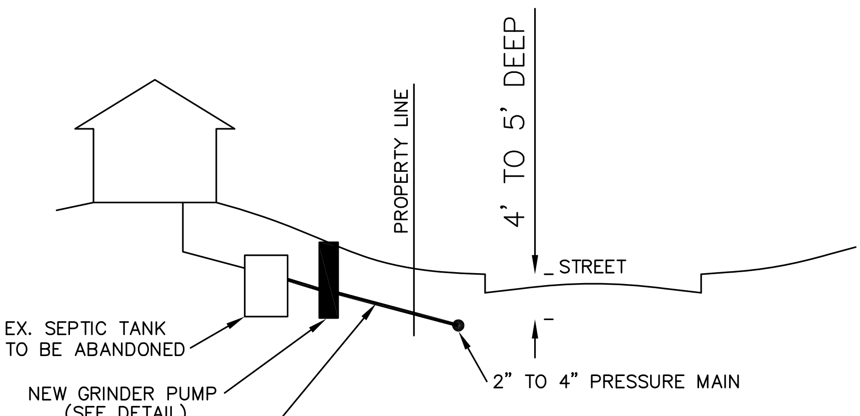
VILLAGE OF LUDLOW FALLS

MVRPC UNSEWERED COMMUNITIES

CONVENTIONAL GRINDER SEWER CONNECTION
FIGURE 5-4



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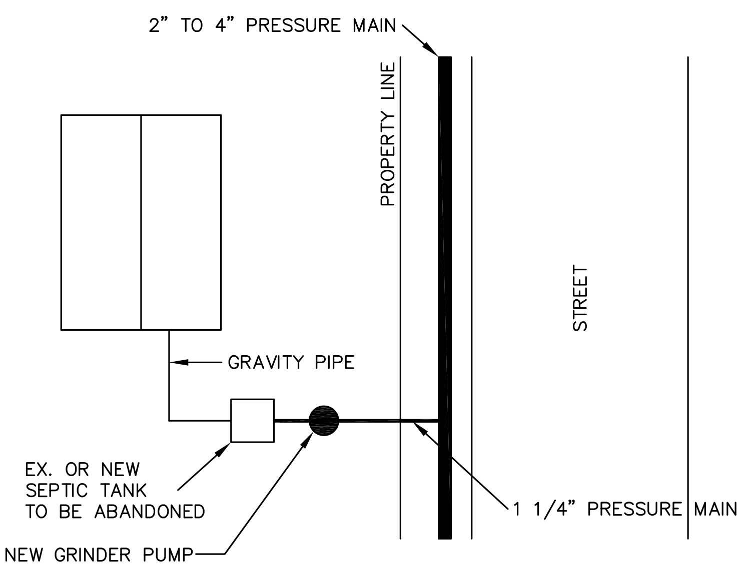
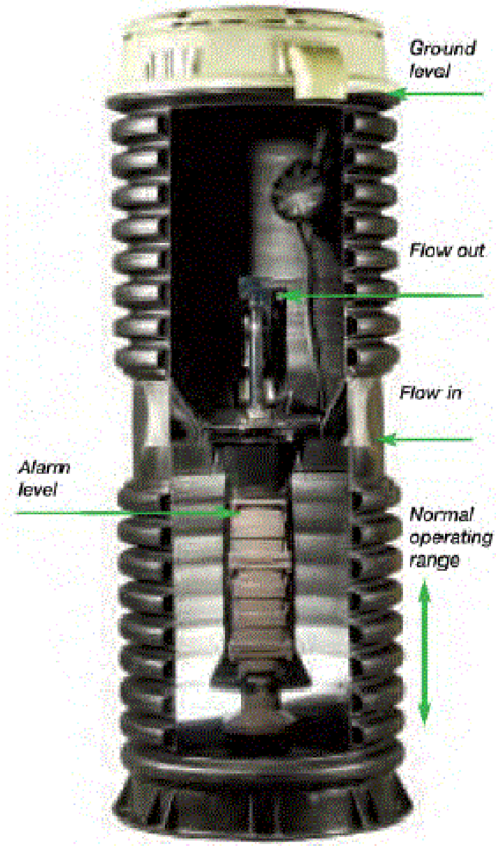


PLAN VIEW (TYP.)



GRINDER DETAIL

GRAPHIC SCALE

0 150 300

(IN FEET)

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COMMUNITIES

SHEET TITLE:

STEP/GRINDER
SEWER LAYOUT

FIGURE 5-5

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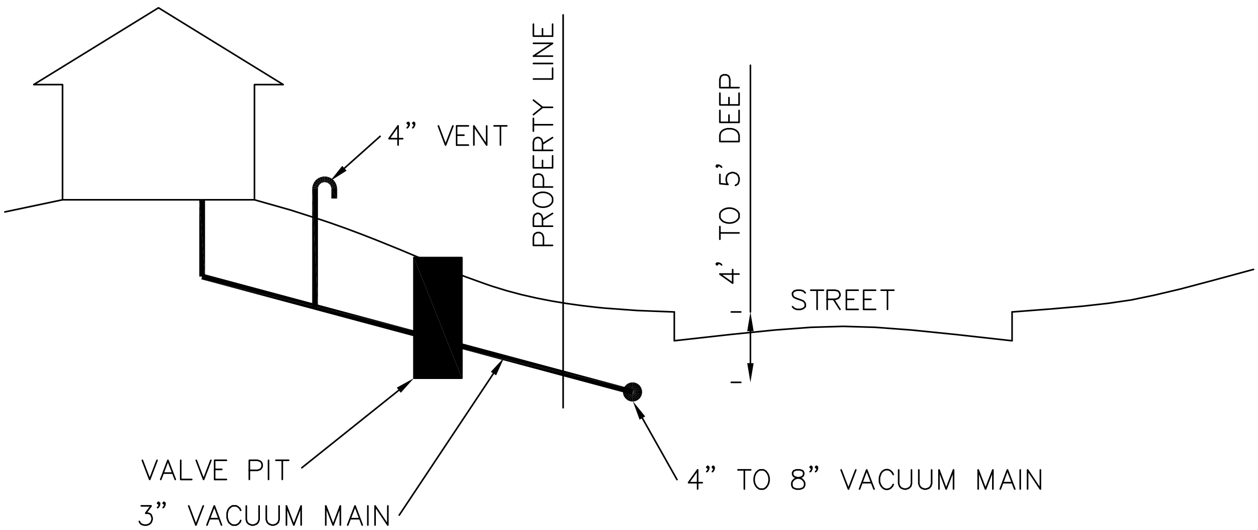
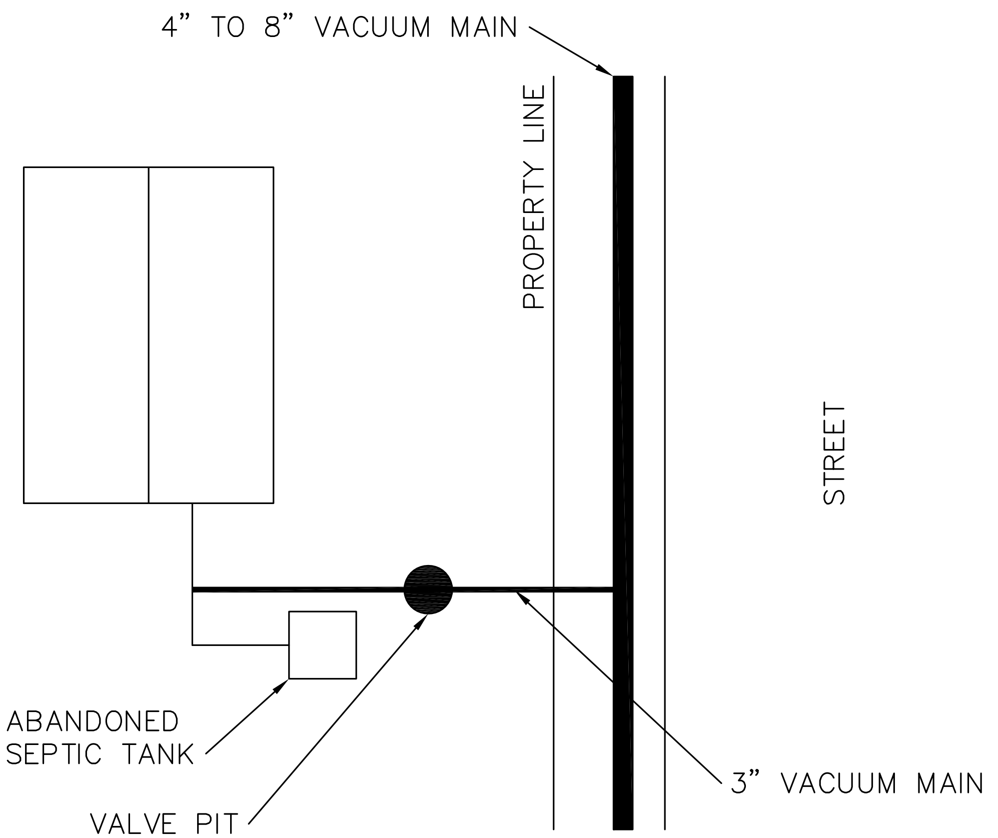
VILLAGE OF LUDLOW FALLS

MVRPC UNSEWERED COMMUNITIES

CONVENTIONAL VACUUM SEWER CONNECTION
FIGURE 5-7



SECTION (TYP.)



PLAN VIEW (TYP.)

LEGEND
SANITARY PIPE
SANITARY LATERAL

GRAPHIC SCALE
0 150 300
(IN FEET)

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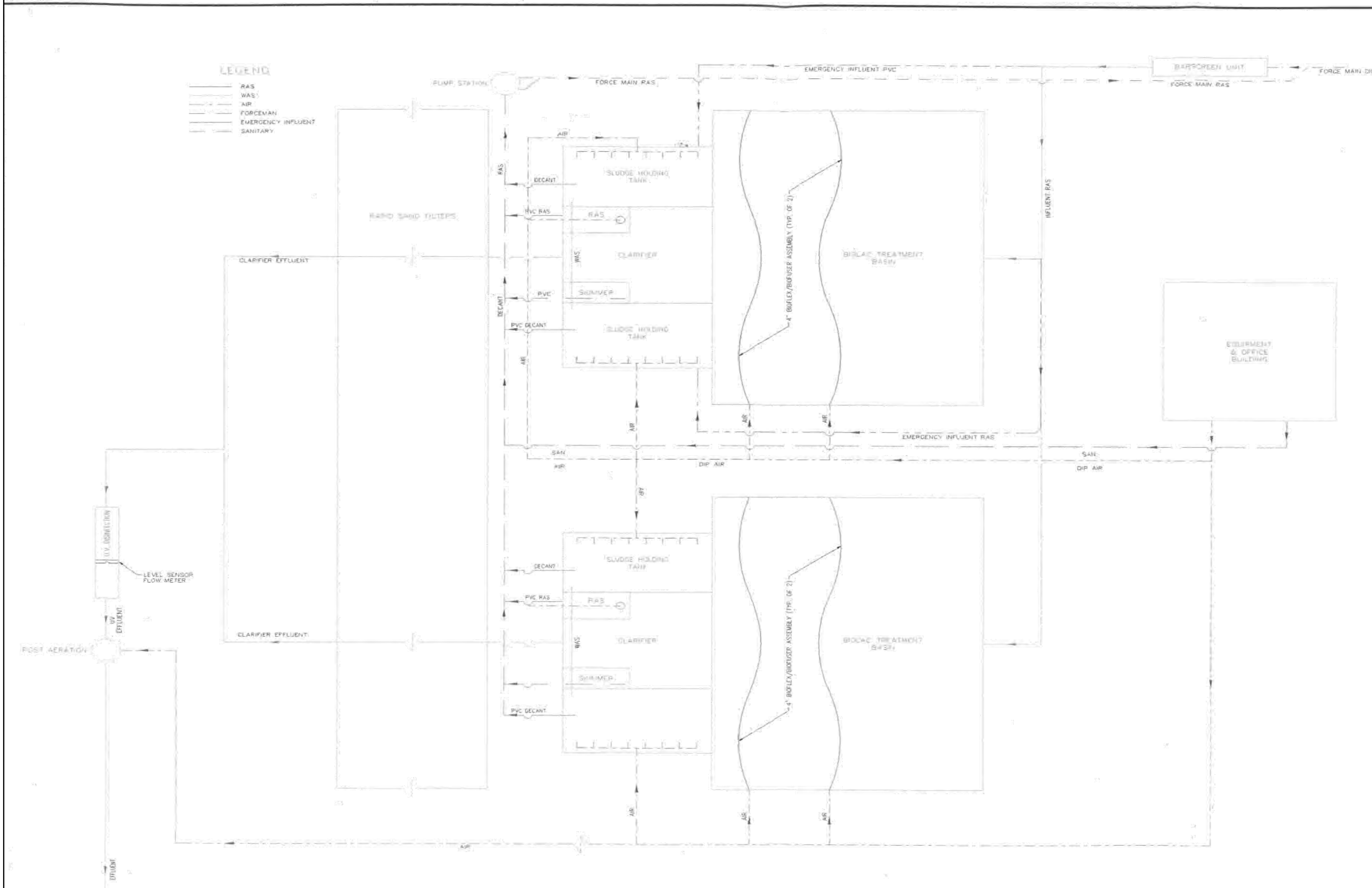
SHEET TITLE:

VACUUM SEWER
LAYOUT

FIGURE 5-7



PROCESS FLOW SCHEMATIC
(NO SCALE)

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SHEET TITLE:

EXTENDED
AERATION
TREATMENT
PROCESS

FIGURE 5-8

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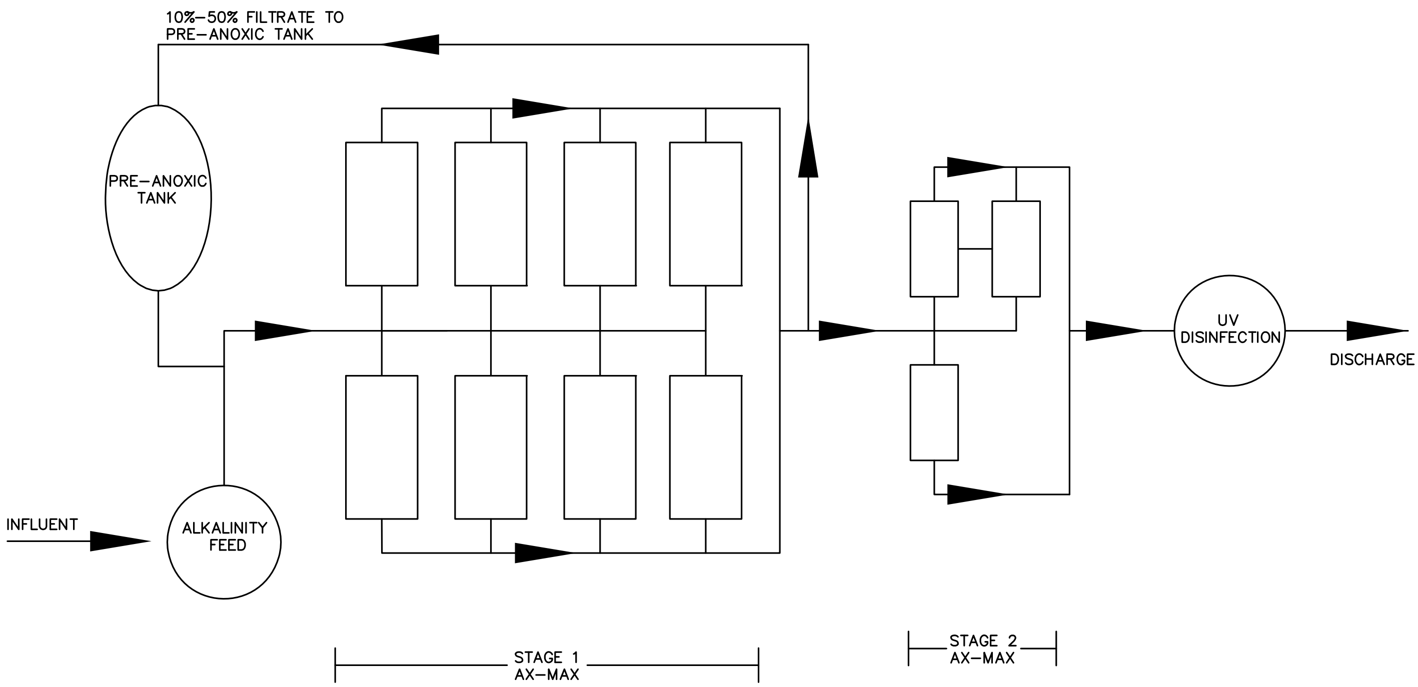
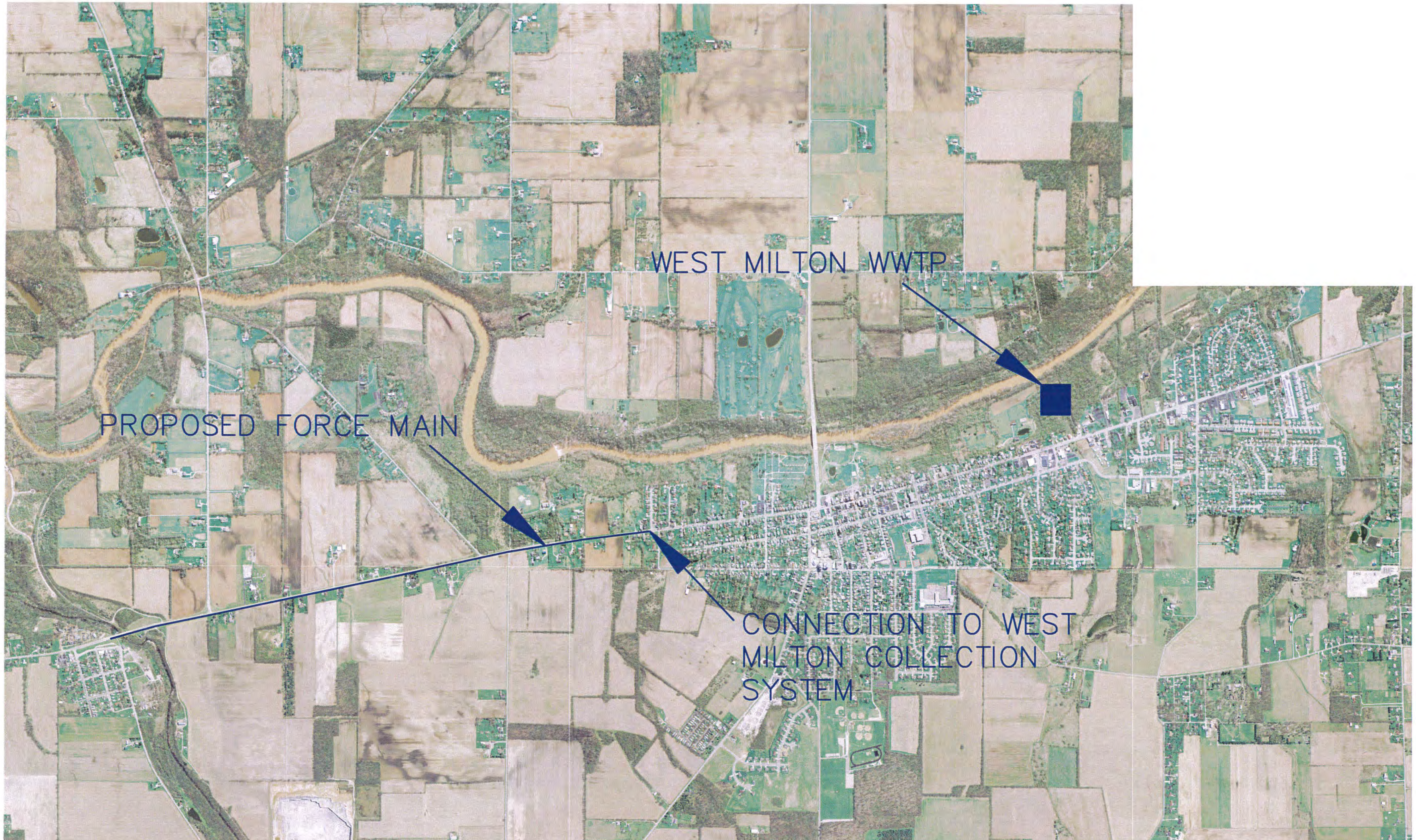
VILLAGE OF LUDLOW FALLS

MVRPC UNSEWERED COMMUNITIES

PACKED BED MEDIA TREATMENT SYSTEM
LAYOUT
FIGURE 5-9





GRAPHIC SCALE

0 875 1750

(IN FEET)

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LUDLOW FALLS/WEST MILTON
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UNSEWERED
COMMUNITIES

SHEET TITLE:

FORCE MAIN TO
WEST MILTON

FIGURE 5-10

GRAPHIC SCALE

0 100 200

(IN FEET)

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MVRPC UNSEWERED COMMUNITIES

SHEET TITLE:

POSSIBLE WWTP LOCATION

FIGURE 5-11

The alternatives presented in this study are evaluated economically by comparing their present worth. The present worth of an alternative is the amount of money invested at 6 percent, which would provide the funds needed for all expenses during the life of the project (including O,M&R, but not including inflation). This provides a method of comparing the real costs of each system in its entirety, as opposed to the comparison of construction costs only. The procedures used in developing present worth are as follows:

Contingency

Contingency costs are capital costs incurred to purchase and install each component of a collection alternative. These costs are estimates for a future construction date and include a 10 percent design contingency. Contingency costs typically costs for the following:

- Sewers, force mains, and pump stations
- Fittings and valves
- Earthwork
- Pavement replacement
- Grading and seeding
- Boring and jacking under railroads, highways, and streams
- Granular backfill Bid margin
- Design contingency
- Appurtenances

Contingency cost estimates for the various alternatives are included in the individual estimates.

Non - Construction Costs

Non-construction costs are calculated at 20 percent of the sum of the construction cost and contingency cost. They include the following:

- Engineering, legal, and administrative cost
- Easements
- Interest during construction
- Initial operation
- Construction inspection and administration
- Financing/Funding Administration

Operation, Maintenance, and Repair

O,M&R costs are those costs associated with the daily or periodic inspection/ upkeep of the proposed collection system. They include, but are not limited to, the following:

- Salary – Labor costs are based on the number of operating personnel required including benefits.
- Pump Stations - O,M&R costs including inspections, repairs to impellers and bearings, etc.
- Collection System – Maintenance costs are historically calculated at a unit cost per mile of collection pipe. Unit costs vary according to type of system.
- Electrical – Electrical costs associated with pump stations, effluent pumps, and vacuum stations.
- Office & Overhead – Costs associated with the monthly billing operations such as paper, stamps, computers, and personnel.

The O,M&R costs associated with the gravity, STEP, vacuum, and grinder collection systems are as follows:

Table 6-1: Collection System O,M&R Costs

Gravity Collection System

ITEM	DESCRIPTION	COST
1	COLLECTION SYSTEM MAINTENANCE	$2,000
2	EQUIPMENT REPLACEMENT	$2,000
TOTAL		**$4,000**

Septic Tank Effluent Pump Collection System

ITEM	DESCRIPTION	COST
1	PRIMARY TANK PUMP OUT (90 tanks based on 7 year frequency @ $400 per tank)	$5,000
2	PRO-ACTIVE PREVENTITIVE MAINTENANCE (pump and controls inspection annually)	$3,000
3	REACTIVE MAINTENANCE (repairs to pump components)	$1,000
4	EQUIPMENT REPAIR AND REPLACEMENT (pump replacement frequency 10 years)	$3,500
TOTAL		**$12,500**

Grinder Pump Collection System

ITEM	DESCRIPTION	COST
1	PRO-ACTIVE PREVENTITIVE MAINTENANCE (pump and controls inspection annually)	$5,000
2	REACTIVE MAINTENANCE (repairs to pump components)	$3,500
4	EQUIPMENT REPAIR AND REPLACEMENT (pump replacement frequency 10 years)	$7,000
TOTAL		**$15,500**

Vacuum Collection System

ITEM	DESCRIPTION	COST
1	VACUUM STATION POWER	$4,000
2	PRO-ACTIVE PREVENTITIVE MAINTENANCE	$2,000
3	REACTIVE MAINTENANCE	$1,000
4	EQUIPMENT REPAIR AND REPLACEMENT	$4,000
TOTAL		**$11,000**

The O,M&R costs associated with the treatment systems are as follows:

Table 6-2: Treatment Systems O,M&R Costs

Extended Aeration Treatment

ITEM	DESCRIPTION	COST
1	LABOR & ADMINISTRATION	$30,000
2	CHEMICALS	$1,500
3	POWER	$2,500
4	LABORATORY	$2,000
5	SLUDGE HANDLING	$3,000
6	EQUIPMENT REPAIR AND REPLACEMENT	$6,000
TOTAL		**$45,000**

Lagoon Treatment System

ITEM	DESCRIPTION	COST
1	LABOR & ADMINISTRATION	$20,000
2	CHEMICALS	$2,000
3	POWER	$2,000
4	LABORATORY	$2,000
5	EQUIPMENT REPAIR AND REPLACEMENT	$3,000
TOTAL		**$29,000**

Packed Bed Media Treatment System

ITEM	DESCRIPTION	COST
1	LABOR & ADMINISTRATION	$20,000
2	CHEMICALS	$1,000
3	POWER	$1,500
4	LABORATORY	$1,000
5	EQUIPMENT REPAIR AND REPLACEMENT	$3,000
TOTAL		**$26,500**

Transport to West Milton

ITEM	DESCRIPTION	COST
1	WEST MILTON TREATMENT CHARGES (based on $8.23/1,000 gal – 30,000 GPD)	$90,000
TOTAL		**$90,000**

Summary

The previously identified sewer system alternatives have been analyzed for feasibility based on existing and future projected demands, regulatory considerations, estimated costs and with regional service options based on user rate analysis. The following section will identify the recommended alternative based on the factors listed above.

The estimated costs for each collection and treatment alternative have been developed and are presented in the Tables below. These tables include the total project cost, estimated annual O,M&R costs, and present worth cost.

A 20-year present value analysis was used to compare alternatives against each other. Present value, also known as present worth or present discounted value, is the value on a given date (i.e. the present) for a future payment or series of future payments, discounted to reflect the time value of money. Present value calculations are widely used in engineering economics to provide a means to compare costs at different times on a meaningful "like to like" basis.

Criteria and factors used in the present value analysis include the following:

Design Life	20 years
Replacement Period	10 years
Discount Rate	6 percent
O,M&R Present Worth Factor	11.4699

The following pages show each possible collection and treatment option for the Village of Ludlow Falls.

The first option in a table is the collection system alternative, and the treatment alternative is listed directly below. The project cost of each of these is listed in the project cost column. The O,M&R for each option is listed in the O,M&R column. The present worth for each of the options is calculated by multiplying the O,M&R cost by the present worth factor (11.4699) and adding the project cost. The bold number in the table represents the total project present worth cost for that collection and treatment combination.

Gravity Sewer System

	Project Cost	O,M&R	Present Worth
Gravity	$1,472,510	$4,000	$1,518,390
Extended Aeration	$959,640	$45,000	$1,475,786
Total	$2,432,150	$49,000	**$2,994,175**

	Project Cost	O,M&R	Present Worth
Gravity	$1,472,510	$4,000	$1,518,390
Lagoon	$1,012,440	$29,000	$1,345,067
Total	$2,484,950	$33,000	**$2,863,457**

	Project Cost	O,M&R	Present Worth
Gravity	$1,472,510	$4,000	$1,518,390
Pump to West Milton	$0	$90,000	$1,032,291
Total	$1,472,510	$94,000	**$2,550,681**

STEP Sewer System

	Project Cost	O,M&R	Present Worth
STEP Sewer	$1,268,371	$12,500	$1,411,745
Packed Bed Media	$1,482,624	$26,500	$1,786,576
Total	$2,750,995	$39,000	**$3,198,321**

Grinder Pump Sewer System

	Project Cost	O,M&R	Present Worth
Grinder Sewer	$1,342,413	$15,500	$1,520,196
Extended Aeration	$959,640	$45,000	$1,475,786
Total	$2,302,053	$60,500	**$2,995,982**

	Project Cost	O,M&R	Present Worth
Grinder Sewer	$1,342,413	$15,500	$1,520,196
Lagoon	$1,012,440	$29,000	$1,345,067
Total	$2,354,853	$44,500	**$2,865,264**

	Project Cost	O,M&R	Present Worth
Grinder Sewer	$1,342,413	$15,500	$1,520,196
Pump to West Milton	$0	$90,000	$1,032,291
Total	$1,342,413	$105,500	**$2,552,487**

Vacuum Sewer System

	Project Cost	O,M&R	Present Worth
Vacuum Sewer	$1,542,643	$11,000	$1,668,812
Extended Aeration	$959,640	$45,000	$1,475,786
Total	$2,502,283	$56,000	**$3,144,597**

	Project Cost	O,M&R	Present Worth
Vacuum Sewer	$1,542,643	$11,000	$1,668,812
Lagoon	$1,012,440	$29,000	$1,345,067
Total	$2,555,083	$40,000	**$3,013,879**

	Project Cost	O,M&R	Present Worth
Vacuum Sewer	$1,542,643	$11,000	$1,668,812
Pump to West Milton	$0	$90,000	$1,032,291
Total	$1,542,643	$101,000	**$2,701,103**

As mentioned earlier the best way to look at the price of the wastewater system is to look at the present worth. The gravity sewer system with the option to pump the wastewater to West Milton has the lowest present worth.

Conclusions

The previously identified wastewater collection and treatment system alternatives have been analyzed to determine the best collection system and treatment system scenario for the Village of Ludlow Falls. Each of these scenarios took the project cost, O,M&R cost, and the environmental conditions into consideration to provide the Village of Ludlow Falls a viable option for a future wastewater system.

Recommendations

Based on the cost analysis, the best option for the Village of Ludlow Falls is to construct a gravity collection system and contract with the Village of West Milton for treatment services assuming West Milton will cover the cost of construction of a pumping station and forcemain from Ludlow Falls to West Milton.

The initial capital cost of a gravity collection system is higher than either a STEP sewer or grinder sewer system, but the annual O, M&R costs are significantly lower and when a Present Worth analysis is run, these differences become apparent.

Construction of a gravity sewer will also require sewers to be deeper than the two pressurized collection systems requiring rock excavation. Rock excavation has been accounted for in the construction estimate. Construction will be slower and cause more disruption, but is temporary and with a responsible contractor, the residents should be able to manage through the construction process, especially considering that a good majority of the sewer lines could be located in alleyways and away from the streets.

Chapter 8 – Funding

There are several Federal and State funding sources available to help assist in covering the cost of this project. Below are several sources which Ludlow Falls may consider with the project. These include both grants and low-interest loans.

Each year, qualified communities are bypassed in the apportioning of public funds, not for lack of need or eligibility, but simply because of failure to meet deadlines and provide necessary documentation. With the assistance of a qualified funding consultant, communities can be assisted in the time-consuming and laborious task of applying for grants and loans.

Federal Funding

Community Development Block Grants (Grant Program)

Approximately $20.4 million is average annually split up among Ohio Counties. Counties typically fund 3 to 4 projects up to $50,000. Financing is available in the form of supplemental grants. To be eligible for this grant, the project benefit area must include at least 51% Low to Moderate Income (LMI) households. The Village of Ludlow Falls 2014 Low Moderate Income is currently listed as 58.7%. Applications are due to the County in the Spring of each year.

State Funding

Ohio Public Works Commission (Grant/Loan Program)

Financing is available in the form of grants and loans with varying interest rates. Grants may pay up to 50% of water or sewer project costs for new projects and up to 90% for repair or replacement projects. Loans may fund up to 100% of total project costs, each district will recommend an interest rate from 0% to 3% interest. The Loan Assistance is a grant that pays for the interest on a public or private loan during the construction period plus one year. Once project is complete a payment schedule is provided requiring payments every January and July, there is no prepayment penalty.

Ohio Water Development Authority (Loan)

Financing is available in the form of a loan program to plan, design and construct projects. The loan interest rate is current market rate. Discount rates are offered to previous borrowers and disadvantaged communities. The Village of Ludlow Falls has a Median Household Income of $32,500 (according to the 2014 American Community Survey), and would be considered a disadvantaged community. The loan has a term of 5 to 30 years. To date, all eligible applicants have been funded.

Residential Public Infrastructure (Grant) - CDBG

Grants are available on a competitive basis up to $480,000, at a $1 to $1 (other funds) ratio for projects benefiting at least 51% LMI households. Applications are due 2nd Quarter of each year. The Village of Ludlow Falls 2014 Low Moderate Income is 58.7%.

Unsewered Area Assistance Program (Grant) - OWDA

Grants are available for construction of a publicly owned sewer system for un-sewered areas that have failing on-lot sanitary systems. The project area must have a Median household Income below the state MHI ($32,500), per the American Community Survey. The Village of Ludlow Falls MHI is $32,500 and has under 200 customers, they could possibly qualify for $250,000 in grant funding under this program.

Water Pollution Control Loan Fund (Loan) - OEPA

Financing is available through a revolving fund designed to operate in perpetuity to provide low interest rate loan and other forms of assistance for water resource protection and improvement projects. Interest rates are determined by project areas Median household Income. The Village of Ludlow Falls' MHI is $32,500 and would qualify for an interest rate of 0% for 20 years. Applications may be submitted requesting a 30 year loan and cannot exceed the project useful life.

Table8-1: Funding Summary

In order to fund this project, the following funding plan is proposed:

			GRAVITY SEWER WEST MILTON TREATMENT
CUSTOMERS/EDUs			100
PROJECT COST- Collection System			$1,472,510
ANNUAL O,M&R			$0
FINANCING			
CDBG Formula Grant			$30,000
Residential Public Infrastructure Grant			$480,000
OPWC Grant			$400,000
Unsewered Area Assistance Program			$250,000
Local Funds - Capacity Fee $1,500/EDU			$150,000
OPWC Loan	30	0.00%	$162,510
OWDA Loan	30	2.00%	$-
OEPA WPCLF Loan	30	0.00%	$-
Total Financing			$1,472,510
ANNUAL DEBT			
Annual OPWC Payment			$5,417
Annual OWDA Payment			$-
Annual OEPA WPCLF Payment			$-
ANNUAL DEBT PAYMENT			$5,417
DEBT PAYMENT PER MONTH PER EDU			$4.51
O,M&R PAYMENT PER MONTH PER EDU			$-
TOTAL PER MONTH PER EDU (not including treatment charges)			**$4.51**

The above table shows a realistic funding plan for the construction of a gravity collection sewer system. Under this scenario, the majority of the project cost would be covered under grant programs with a much smaller portion through loan.

We have shown a $1,500 capacity fee for each customer in the table above. A capacity fee (or otherwise known as a tap fee) is an upfront cost collected from each connection or customer to assist in covering the project cost. It would be up to the Village whether or not to include a capacity fee into the project. Many communities constructing a new sewer system will not charge a capacity fee for existing homes and businesses, but will enact legislation requiring a capacity fee for future homes constructed. If removed, the loan amount will be increased to cover the deficit and monthly debt payment will increase as well.

The bottom line in this table indicates the amount of debt payment for each customer. This debt payment will be in addition to the standard monthly billing to the Village of West Milton. West Milton recently enacted a 30% surcharge on out of town customers. With this surcharge, the rate to Ludlow Falls would be as shown in the following table:

Table 8-2: Monthly Debt Payment

Operation Charge	Consumption Charge (per 1,000 Gallons)
$8.79	$9.14

Each resident can calculate what their typical sewer bill would be based on their current water bill. For simplicity, the table below is provided based on a monthly water usage between 2,000 gallons per month to 6,000 gallons per month.

Table 8-3: Typical Monthly Sewer Payment

Water Usage (gal/month)	Operation Charge	Consumption Charge	Debt Payment	Total Monthly Bill
2,000	$8.79	$18.28	$4.51	$31.58
3,000	$8.79	$27.42	$4.51	$40.72
4,000	$8.79	$36.56	$4.51	$49.86
5,000	$8.79	$45.70	$4.51	$59.00
6,000	$8.79	$54.84	$4.51	$68.14

Chapter 9 – Arrangement for Implementation

Institutional Responsibilities

The Village of Ludlow Falls has the necessary statutory authority for implementing this system and has the necessary legal, financial, institutional, and managerial resources available to ensure construction and O,M&R of the proposed collection system. The proposed collection system involves the Village of Ludlow Falls, MVRPC, Union Township, and the Village of West Milton. Various Ordinances and Resolutions of Agreement will have to be passed by the governmental bodies to implement the Village and surrounding areas collection and treatment system.

Implementation Steps

The Village of Ludlow Falls would be the primary stakeholder in this project. Union Township would also be involved with this project in that the sewer system will be constructed within their jurisdiction. They will have varying degrees of direct managerial and supervisory responsibilities for the proposed Ludlow Falls collection facility. The owner will be assisted by the engineer in the preparation of detailed plans, construction, and O,M&R of the proposed facility.

The Village plans to finance the project through grants, loans, and user charges. The user charges will be programmed to provide adequate monies to meet bond retirement obligations and operate and maintain the proposed facility, without placing undue burden on local citizens.

The following steps should be completed in order to implement facilities plan recommendations:

1. Completion of the final “facilities plan” and submission for approval by local, regional, and state agencies.
2. Preparation of detailed plans and specifications for the proposed improvements.
3. Submission of the detailed plans and specifications for the proposed system, along with preparation of a financing agreement for State approval.
4. Preparation of all funding applications such as Ohio EPA, OPWC, CDBG, etc.
5. Execution of financial agreements, concurrent with grant/loan approval.
6. Advertisement for bids, bid evaluation, and award of contracts.
7. Construction of proposed system.
8. Preparation of operation and maintenance manual.
9. Employment of additional operation, maintenance, and administrative personnel.
10. Initiation of operation of the improved facilities.

The following implementation schedule is feasible and represents the shortest time to project implementation:

Planning:	
Submit completed feasibility plan	June, 2015
Design:	
Authorization to start engineering design	October, 2015
Submit for OWDA planning loan	November, 2015
Completion of detailed plans	August, 2016
Obtain district and Ohio EPA approval	October, 2016
Finalize funding applications	April, 2017
Construction:	
Advertisement for bids	June, 2018
Receive bids	August, 2018
Award contracts	September, 2018
Complete construction	August, 2019
Final inspection	October, 2019

Operation, Maintenance, and Monitoring

It is assumed the Village of West Milton will perform all O, M&R of the Ludlow Falls collection system as part of the current rate structure. As such, Ludlow Falls will have minimal responsibility with the daily operations beyond ensuring the debt payment is made to the funding agencies. It is further assumed Ludlow Falls and West Milton will be able to negotiate the debt payment into the monthly bill to each resident to cover this cost.

Chapter 10 – Summary of Environmental Considerations

Future Environment without Project

The future environment of the unsewered areas with a "no action" policy would allow for the continuation of present conditions to go unabated. This would allow improperly treated wastewater from individual residences to drain into the surrounding natural waterways causing local water pollution problems. Taking no action to solve existing wastewater management problems within the study area would result in the continued malfunctioning of individual soil absorption systems and the surface ponding and discharge of improperly treated septic tank effluent. High fecal coliform levels in roadside ditches preclude compliance with Ohio's Water Quality Standards and present potential health risks to area residents. Because this alternative does not meet the "effectiveness" criteria established by Ohio's Water Quality Standards, it was eliminated from further environmental evaluation.

Environmental Evaluation of Alternatives and Selected Plan

The environmental impacts of each alternative include primary and secondary impacts. The primary impacts are those directly related to the construction and operation of the facility. The secondary impacts are induced changes in the patterns of land use, population growth or the resultant effects upon the environment caused by these changes. Both adverse and beneficial impacts must be considered. Items included in this evaluation are the following:

- Air, land, and water quality
- Public Health
- Environmental aesthetics
- Historical and cultural area
- Noise and odors

Air, Land, and Water Quality

Each of the alternatives involving construction will have an initial detrimental or negative impact on air quality near the construction site.

An increase in total suspended particulates in the form of dust, carbon monoxide, and photochemical oxidents is anticipated during the construction period. The increase is a result of diesel and gasoline powered internal combustion engines. The alternatives involving large construction sites will impose a negative initial impact on air quality. The "no action" alternative will have the least negative impact on air quality except for occasional odors.

The overall secondary or induced impact will be beneficial as odors will be reduced. A gravity collection system or vacuum collection system will have the least impact associated with odors where STEP systems or grinder systems may have odor impacts.

Each of the alternatives involving construction will have an initial negative primary impact on the land at the construction site. During and immediately after construction, the land will appear scarred and lacking suitable cover. Erosion will probably occur, creating unsightly washes, puddles and small gullies. The alternatives involving larger construction sites will experience greater negative impact. The secondary impacts will have essentially no impact, beneficial or adverse, on land or development.

Each of the alternatives involving construction will have an initial adverse impact on water quality near the construction site. Erosion will result in an increase in suspended solids and turbidity in area streams. The secondary impact on water quality will be beneficial for all alternatives with the exception of the “no action” alternative. It will result in a considerably lower organic, nutrient and ammonia loadings to the receiving streams.

Public Health

All of the alternatives, with respect to the “no action” alternative, will result in a beneficial primary and secondary effect on public health.

Environmental Aesthetics

The impact of the various alternatives on environmental aesthetics are closely related to the impacts on land and water quality. The immediate primary impact during construction is adverse. The smallest construction site represents the least adverse effect on environmental aesthetics. The ‘no action” alternative will result in no construction impacts.

Historical and Cultural

Each of the alternatives including the “no action” alternative will have no impact on any of the historical/archaeological or cultural elements within the planning area.

Noise and Odors

Each of the alternatives, except for the “no action” alternative will result in noise and odors inherent to construction activities. These adverse impacts will vary depending upon the extent of the construction activity and the proximity to existing residences. The secondary impacts will be virtually non-existent.

Selected Plan Environmental Impacts

The recommended plan for the study area is the construction of a Gravity sewer collection system and to pump the wastewater to the Village of West Milton for treatment. Gravity sewers have the advantage of delivering non-septic sewage to the treatment plant by allowing free flows of sewage through the sewers. Even with the pump station, there will be low operation and maintenance of the sewers. There are high construction costs associated with this alternative with possible requirements of deep excavations to maintain an adequate slope to the sewer. The construction activities will include removal of vegetative cover, noise, dust and occasional odors. A slight degree of water quality degradation may take place after rainstorms as a result of erosion and siltation. The secondary impacts of the proposed action will be beneficial. Gravity sewers are a highly reliable alternative.

Mitigation Measures

Adverse impacts expected from the proposed action will primarily occur during the construction phase. The beneficial long-term impacts must outweigh the short-term adverse impacts for the project to be viable. To insure that the project does not harm the environment, mitigative measures must be taken to lessen the adverse effects of the proposed plan.

Erosion/Dust Control

The soil surface will be exposed only for the minimum amount of time to facilitate construction. Sewers, force mains and appurtenances will be aligned along existing right-of-way and easements to minimize the destruction of vegetative cover. Reseeding and mulching will follow construction as soon as possible. Topsoil removed during construction will be stockpiled for reuse at the site. Terracing, erosion control structures and contouring will be incorporated in the design. Dust control measures will include periodic sprinkling of exposed earth surfaces.

Archaeological/Historical Preservation

The proposed action will not have any impact on known historical or archaeological sites within the planning area. Therefore, no mitigative measures will be required. The Ohio Historic Preservation Office will be notified immediately upon discovery of unknown artifacts uncovered during construction.

Vegetation

As previously mentioned, the construction sites have been selected to minimize disturbance of vegetative cover. Exposed areas will be seeded upon settling and final grading. Fertilizing and watering will be included in routine site maintenance.

Noise Control Practices

Construction equipment will be required to have exhaust mufflers as required by safety standards. Construction activities in close proximity to residential areas will be limited to daytime working hours.

Odor Control Practices

With proper O,M&R, including routine cleaning and sewer maintenance, no objectionable odors should be produced.