In cooperation with the Chippewa Subdistrict of the Muskingum Watershed Conservancy District

Stream-Profile Analyses Using a Step-Backwater Model for Selected Reaches in the Chippewa Creek Basin in Medina, Wayne, and Summit Counties, Ohio

Scientific Investigations Report 2011–5024

U.S. Department of the Interior
U.S. Geological Survey

Cover photo. Chippewa Creek looking upstream from Shorle Road.

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By David E. Straub and Andrew D. Ebner

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U.S. Geological Survey
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Conversion Factors and Abbreviations

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
centimeter (cm)	0.3937	inch (in.)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
square foot (ft^2)	0.09290	square meter (m^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume per unit time (includes flow)	
cubic feet per second (ft^3/s)	28.32	cubic decimeter per seond (dm^3/s)
	Volume	
acre-foot (acre-ft)	1,233	cubic meter (m^3)
	Flow rate	
foot per second (ft/s)	0.3048	meter per second (m/s)

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Other abbreviations

FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
GPS	Global Positioning System
HEC-RAS	Hydrologic Engineers Center's River Analysis System
MWCD	Muskingum Watershed Conservancy District
SCS	Soil Conservation Service
TIN	Triangular Irregular Network
USGS	U.S. Geological Survey

Stream-Profile Analyses Using a Step-Backwater Model for Selected Reaches in the Chippewa Creek Basin in Medina, Wayne, and Summit Counties, Ohio

By David E. Straub and Andrew D. Ebner

Abstract

The U.S. Geological Survey, in cooperation with the Chippewa Subdistrict of the Muskingum Watershed Conservancy District, performed hydrologic and hydraulic analyses of selected reaches of three streams in the Chippewa Creek basin in Medina, Wayne, and Summit Counties, Ohio to aid in the assessment of alternatives for channel improvements for mitigating flood hazards. Peak flows with a 50-percent annual exceedance probability (the 2-year flood) were estimated from regional regression equations as an approximation of bankfull discharges. Drainage areas of the three stream reaches studied ranged from 29.6 to 188 square miles.

The Hydrologic Engineers Center's River Analysis System step-backwater model was used to compute water-surface-elevation profiles for the 2-year flood along selected reaches of the streams. The base model was modified to determine the effects of reducing main-channel roughness coefficients (Manning's *n*) by 5, 10, 15, and 20 percent on the computed water-surface profiles. Reach-averaged reductions in water-surface elevations ranged from 0.11 to 1.29 feet over the four roughness reduction scenarios.

Introduction

The Chippewa Creek valley was a series of swamps until channel modifications drained it and turned it into a productive agricultural region by 1900. Without a systematic maintenance program, the channels reverted back to their natural conditions and flooding became a problem. In June 1956, the Soil Conservation Service (SCS) developed a watershed-protection and flood-control plan (U.S. Department of Agriculture, 1956) that called for 33.2 miles of modified channels and 8 floodwater-retention structures (fig.1). The channel modifications included straightening the channel of selected stream reaches of Chippewa Creek, Westfield Ditch, Little Chippewa Creek, and River Styx. A trapezoidal channel geometry was constructed to increase the efficiency of the channel to convey the floodwater out of the basin. The floodwater-retention structures were designed to attenuate flood-peak streamflows. The effects of these flood-control features were estimated to reduce the annual average flooded area by approximately 4,210 acres. (Muskingum Watershed Conservancy District, 1961).

After three amendments to the original plan, in which the primary changes were the locations of conservation pools upstream from the floodwater-retention structures, the final version of the Chippewa Subdistrict's Official Plan (Muskingum Watershed Conservancy District, 1961) was adopted in March 1977. All channel modifications and floodwater-retention structures of this plan were completed by 1980.

The floodwater-retention structures have been maintained by the Chippewa Subdistrict of Muskingum Watershed Conservancy District (MWCD). Over time, however, the streams have developed significant tree and brush growth along the channel, thus decreasing the ability of the stream to convey floodwaters out of the basin. In 2007, a section of Chippewa Creek between Shorle Road and Miller Road was cleared of debris, trees, and brush (figure 2). The downstream channel reach of Chippewa Creek still (as of 2010, figure 3) has appreciable tree and brush growth along the channel banks.

The Chippewa Creek basin is undergoing significant development pressure in several areas of the watershed. Traditionally, communities could make use of Flood Insurance Studies (FIS) as an important tool for determining areas that should not be developed. A majority of FIS's conducted by the Federal Emergency Management Agency (FEMA) in the Medina County portion of the Chippewa Creek basin were completed in the mid-to-late 1980's. A FIS for Medina County and incorporated areas (Federal Emergency Management Agency, 2008) was released on August 4, 2008, but no new detailed studies were completed as part of this new study. The flood-hazard-inundation areas of the older studies were redelineated over new digital base map information provided by Medina County. A FIS for Wayne County and incorporated areas (Federal Emergency Management Agency, 2009) was adopted on August 18, 2009, and it included new detailed flood profiles that were developed for Chippewa Creek and River Styx for recurrence intervals of 10, 50, 100, and 500 years.

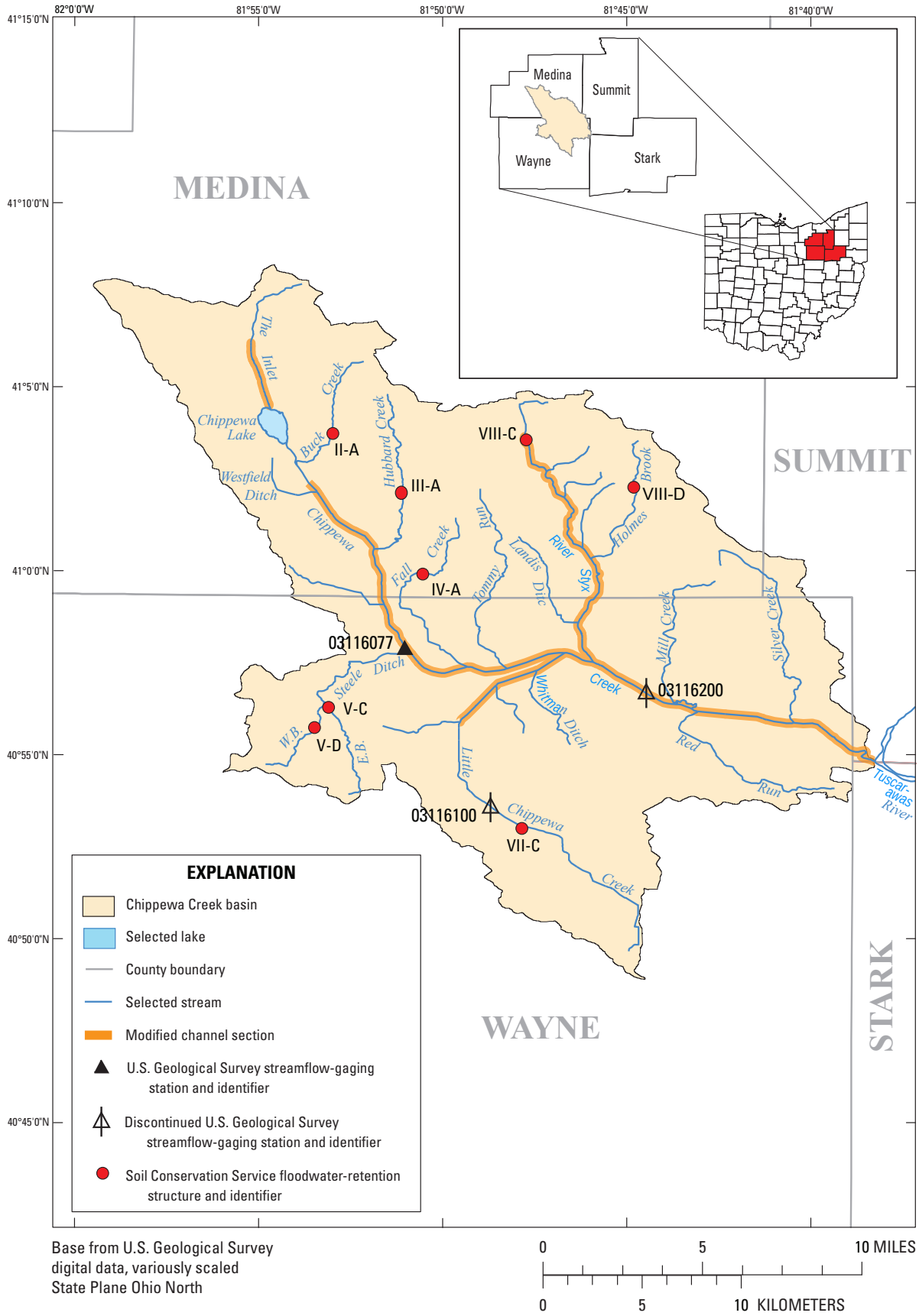

Figure 1. Map depicting selected features of the Chippewa Creek basin in Medina, Wayne, Stark, and Summit Counties, Ohio.

Figure 2. Chippewa Creek looking upstream from Shorle Road.

Figure 3. Chippewa Creek looking upstream from abandoned railroad near mouth.

The Chippewa Subdistrict is concerned about the impact that existing and future development and channel conditions will have on the hydraulic and hydrologic characteristics within the watershed. To aid in the assessment of these impacts and to assist communities making land-use and development decisions, the Chippewa Subdistrict requested that the U.S. Geological Survey (USGS) develop a step-backwater model for selected reaches of Chippewa Creek, Little Chippewa Creek, and River Styx.

Description of Study Area

The Chippewa Creek basin (fig. 1) is located in northeast Ohio, largely in Medina and Wayne Counties but also in small portions of Summit and Stark Counties. The Inlet, which is the headwaters of Chippewa Creek, is a roughly 2-mi reach of stream located west of the city of Medina, and it flows into Chippewa Lake. Chippewa Creek flows out of Chippewa Lake, the largest natural lake in Ohio. Chippewa Creek generally flows south through south-central Medina County, through the village of Seville, and into Wayne County. After flowing through Sterling, Chippewa Creek flows east, passing through the southern edge of the city of Rittman, and eventually flows into the Tuscarawas River in southwestern Summit County (fig. 4). Near the outlet of Chippewa Lake, some of the flow in Chippewa Creek escapes into the headwaters of Westfield Ditch, a tributary of Chippewa Creek, and so Westfield Ditch was modeled as well. Little Chippewa Creek starts in Wayne County near the city of Orrville and generally flows north to join Chippewa Creek at the south side of the city of Rittman (fig. 4). River Styx begins in Medina County near Wadsworth and generally flows south into Wayne county, along the eastern edge of the city of Rittman, and joins Chippewa Creek at the southeastern side of Rittman (fig. 4). The entire Chippewa Creek basin covers 188 mi^2, with Little Chippewa Creek covering 32.2 mi^2 and River Styx covering 29.6 mi^2.

The Chippewa Creek basin is largely agricultural, and a majority of the basin is used for cultivated crops, pastures, and hay. In cities and villages, a majority of the development is of low intensity or is considered open space (U.S. Geological Survey, 2001). The 2009 population estimates, according to the U.S. Census Bureau, are 174,035 in Medina County and 114,222 in Wayne County.

The USGS currently operates one streamflow-gaging station in the Chippewa Creek basin (fig. 1). That station, Chippewa Creek at Miller Road at Sterling, Ohio (USGS 03116077; fig. 4), was installed in 2002, and data collected by it was used to calibrate the model for Chippewa Creek. Two other streamflow-gaging stations were operated in the Chippewa Creek basin but have been discontinued: Chippewa Creek at Easton, Ohio (03116200), operated from 1959 to 1981, and Little Chippewa Creek near Smithville, Ohio (03116100), operated from 1957 to 1972 (fig.1). Data from these stations were not used to calibrate the model because the stage-discharge relationships have changed over the years.

Flood-Control Modifications

The SCS built structures and modified channels to mitigate the effects of flood flows, as listed in the Chippewa Subdistrict's Official Plan (Muskingum Watershed Conservancy District, 1961). Sections of Chippewa Creek, Westfield Ditch, Little Chippewa Creek, and River Styx were modified to increase conveyance of flood flows by straightening and modifying the channels. The modifications called for a trapezoidal cross section, and the dredged materials were removed from the channel and distributed along the tops of the banks. The embankments formed from the dredged materials increased the main-channel cross-sectional area to convey greater flood flows and provided small impoundments behind the embankments for temporary storage. Any water storage behind the embankments drained back into the channel through small culverts or infiltration through the soil. All of the embankments and structures are within the MWCD jurisdiction.

The plan also called for the construction of eight flood-retention structures. All eight of the SCS flood-retention structures are located on tributaries to Chippewa Creek (fig. 1; table 1). Chippewa Lake is not considered one of the flood-control structures, although it provides some natural storage and flood attenuation. Structures II–A, III–A, IV–A, and V–D have conservation pools above the dam, but VIII–C, VIII–D, V–C, and VII–C are dry dams. The combined flood-storage capacity of all eight flood-control structures, not including the conservation pool storage up to the emergency crest, is 4,987 acre-feet (table 1).

Purpose and Scope

This report presents the methods used for and results of a study to analyze the hydrology and hydraulics of flow within channels of the Chippewa Creek basin to aid in an assessment of various flood-mitigation alternatives. The USGS used the Hydrologic Engineers Center's River Analysis System (HEC-RAS; U.S. Army Corps of Engineers, 2008 a–c) step-backwater model to develop water-surface profiles within selected streams in the basin (table 2) and the reach containing Chippewa Lake (fig. 4). Streamflows determined by use of the USGS Ohio StreamStats program (U.S. Geological Survey, 2008) were used as estimates of bankfull flows in the models; cross-sectional elevation data, hydraulic structure geometries, roughness coefficients (Manning's n), and peak-discharge estimates also were used as model inputs. Potential modifications to the channel were evaluated to determine their effects on water-surface elevations. The roughness coefficients (Manning's n) of the main channel were then reduced by 5, 10, 15, and 20 percent to simulate potential effects of channel clearing and/or modifications on the water-surface profiles.

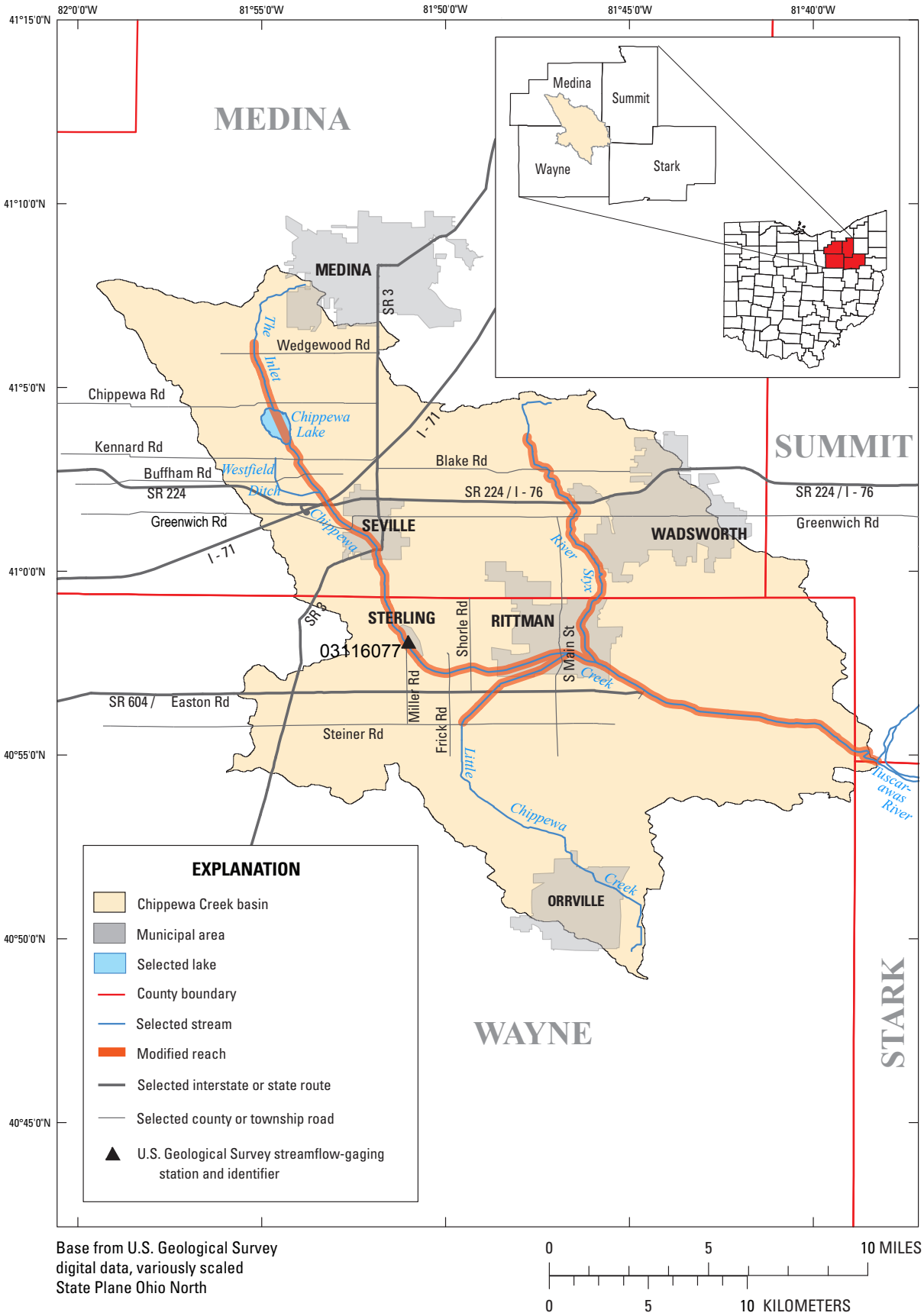

Figure 4. Map depicting selected features pertaining to the models of the Chippewa Creek basin in Medina, Wayne, Stark, and Summit Counties, Ohio.

Table 1. Original design characteristics of the Soil Conservation Service flood-retention structures.

[From U.S. Department of Agriculture, 1956]

Flood-retention structure	Tributary to Chippewa Creek	Storm recurrence interval for flood-retention structure (years)	Year of dam completion	Drainage area above dam (square miles)	Conservation pool storage capacity (acre-feet)	Flood storage capacity up to the emergency crest (acre-feet)
II–A	Buck Creek	25	1969	2.95	77	278
III–A	Hubbard Creek	50	1980	5.88	124	676
IV–A	Fall Creek	25	1973	1.51	16	120
V–C	East Branch Steele Ditch[1]	25	1971	3.73	None	432
V–D	West Branch Steele Ditch[1]	25	1971	1.75	30	156
VII–C	Little Chippewa Creek	50	1974	14.42	None	2,225
VIII–C	River Styx	[2]5.7 inches	1976	3.86	None	673
VIII–D	Holmes Brook[3]	50	1976	2.02	None	427
Totals				**36.12**	**247**	**4,987**

[1] East and West Branch Steele Ditch form Steele Ditch, a tributary to Chippewa Creek.

[2] This dam designed to control a storm runoff of 5.7 inches in 6 hours.

[3] Holmes Brook is a tributary to River Styx.

Table 2. Hydraulic model limits for selected streams in the Chippewa Creek basin, Medina, Wayne, and Summit Counties, Ohio.

Stream	Upstream limit	Downstream limit	Reach length (miles)
The Inlet[1]	About 1,200 feet above Wedgewood Road /State Route 162	About 750 feet below Chippewa Road	2.0
Chippewa Creek[2]	Chippewa Lake	Mouth	19.1
Little Chippewa Creek	Steiner Road	Mouth	3.2
River Styx	Flood Control Structure VII–C	Mouth	7.9

[1] The Inlet is the head of Chippewa Creek.

[2] Westfield Ditch was modeled as an overflow channel to Chippewa Creek.

Study Methods

Data Collection

Field visits were made to the Chippewa Creek basin to determine applicable stream-channel roughness coefficients (Manning's *n*), cross-section elevations, and geometries of hydraulic structures. Cross sections and geometries were surveyed at all structures in each reach. If the distance between structures was more than 1 mi, an open-channel cross section was surveyed by the USGS at a convenient location near the halfway point. By use of a Geographic Information System, a Triangular Irregular Network (TIN) was developed from digital 2-ft contour interval mapping provided by Medina, Wayne, Stark, and Summit Counties to supplement surveyed cross-sectional data. In-channel bottom elevation data for TIN-derived cross sections were estimated by interpolating values between surveyed cross sections. The in-channel bottom width for each TIN-derived cross section was estimated from the "AS-BUILT" plans provided by the MWCD (U.S. Department of Agriculture, 1980) for each stream. The combination of TIN-derived cross sections with interpolated in-channel elevations will be referred to as "synthetic" sections in this report. For this investigation, 246 cross sections were surveyed in the field (table 3) and 484 synthetic sections were developed. Geometries of 56 culverts and bridges and 4 low head dams also were obtained from field surveys.

The initial starting water-surface elevation for each model was determined from a normal-depth calculation in the HEC-RAS model. The initial slope was determined from the minimum channel elevations of surveyed cross sections near the mouth of each stream studied. All models were assumed to be independent of the downstream water-surface conditions. Backwater from the receiving stream was not considered in the beginning of each model. Therefore, the water surface of each model will most likely be lower than the actual water sur-

Table 3. Summary of data collected from field surveys used for the step-backwater models in the Chippewa Creek basin, in Medina, Wayne, Stark, and Summit Counties, Ohio.

Stream	Baseline reference location[1]	Number of surveyed cross sections	Number of synthetic cross sections derived from triangular irregular network	Number of hydraulic structures	Slope used for normal depth calculation (feet per foot)	Manning's roughness coefficient (*n*)[2]			
						Lowest value for main channel	Highest value for main channel	Lowest value for overbanks	Highest value for overbanks
Chippewa Creek	Mouth	127	293	32	0.000167	0.010	0.050	0.035	0.085
Westfield Ditch	Mouth	20	28	5	Not applicable[3]	0.034	0.065	0.045	0.065
River Styx	Mouth	84	108	20	0.000387	0.030	0.040	0.028	0.075
Little Chippewa Creek	Mouth	15	55	3	0.000200	0.035	0.039	0.045	0.045

[1]Downstream limit of the study reach.

[2] Values in these columns are for the current conditions of the reach and do not reflect scenarios of decreasing the roughness coefficient.

[3] The starting water surface elevation was determined from the Chippewa Creek model. No normal depth calculation was needed.

face. In addition, because the normal-depth method was used in each model, the lower reach may not be accurate. Each model had a convergence reach that extended from the start of the model upstream to the point where the estimated water-surface profile and the true water-surface profile met.

The USGS used Global Positioning System (GPS) static surveys to establish a local control network at pertinent locations near the streams studied. Controls for the surveys were established by means of 10 vertical-control monuments, and 5 of those also were horizontal-control monuments (table 4). The USGS benchmarks (14 CWL and 23 EWB) and the National Geodetic Survey benchmarks (964, F281, H281, R176, M176, E281, CHIP, and N177) are described in Appendix 1. Recommended GPS survey guidelines for establishing local networks (Zilkoski and others, 1997) at accuracies of +/- 5 centimeters were followed, except that no facsimiles/reproductions of monuments (rubbings) were obtained. Real-Time Kinematic GPS survey techniques were used to measure horizontal and vertical data at hydraulic structures and at other pertinent locations. Stream and hydraulic structure geometries were obtained using differential leveling techniques. Third-order accuracy (horizontal and vertical) was maintained for all conventional survey data collected. All surveyed data are horizontally referenced to the North American Datum of 1983 (NAD 83) Ohio State Plane (Ohio North) coordinates and vertically referenced to the North American Vertical Datum of 1988 (NAVD 88).

Selected data collected during the GPS field surveys were used by the USGS to perform quality- control checks of the mapping data provided by Medina, Wayne, Stark, and Summit Counties. These checks indicate the digital mapping data for this study meet both horizontal and vertical criteria (applicable for digital mapping produced at 1 in. equal to 500 ft with 2-ft contour-interval data) according to the National Standards for Spatial Data Accuracy (Federal Geographic Data Committee, 1998). The radial Root Mean Square Error was 0.11 ft and the vertical Root Mean Square Error was 0.04 ft.

Hydrology

For the streams studied in this investigation (fig. 4), flows were determined from the USGS Ohio StreamStats program (U.S. Geological Survey, 2008). Flows were computed at several locations on each reach, usually above tributaries along the reach being studied (table 5). StreamStats uses regression equations, based on Koltun and others (2006), with explanatory variables of drainage area, main-channel slope, and storage area. The flows associated with the 2-year recurrence interval were used as an estimate of bankfull flows in the models to facilitate comparison of different channel configuration scenarios. The regression equations used in StreamStats are for rural, unregulated streams and thus are not truly applicable because of the potential influence of the flood-control structures within this basin. Therefore, the 2-year recurrence interval flood-peak flow magnitudes determined with StreamStats may be somewhat larger than the actual 2-year recurrence interval flood-peak flows. The computation of reach specific 2-year flood-peak flows in this basin is beyond the scope of this study.

Table 4. List of benchmarks used to establish a Global Positioning System control network for the surveying of the Chippewa Creek basin and the accuracies of those measurements.

[All monuments are listed in relation to the North American Vertical Datum of 1988 and North American Datum of 1983]

Benchmark name	Published			Surveyed			Differences between published and surveyed values		
	Easting (feet)	Northing (feet)	Elevation (feet)	Easting (feet)	Northing (feet)	Elevation (feet)	Easting (feet)	Northing (feet)	Elevation (feet)
Vertical control monuments									
14 CWL[1]			1006.86			1006.872			-0.01
23 EVB[1]			1187.54			1187.524			0.02
964			964.78			964.730			0.05
F 281			987.80			987.818			-0.02
H 281			970.38			970.418			-0.04
Vertical and horizontal control monuments									
R 176	2127739.740	490818.720	1014.76	2127739.687	490818.642	1014.806	0.05	0.08	-0.05
M 176	2110123.661	505734.123	1131.62	2110123.640	505734.135	1131.614	0.02	-0.01	0.01
E 281	2167257.306	471404.647	963.30	2167257.345	471404.652	963.302	-0.04	-0.01	0.00
CHIP	2172253.527	444678.742	1122.55	2172253.509	444678.658	1122.486	0.02	0.08	0.06
N 177	2184737.090	466800.412	958.04	2184737.265	466800.293	957.964	-0.18	0.12	0.08

[1] Elevation originally reported in relation to the National Geodetic Vertical Datum of 1929 but converted to the North American Vertical Datum of 1988 with Corpscon software (U.S. Army Corps of Engineers, 2004).

Development of Water-Surface Profiles

The HEC-RAS modeling software (version 4.0.0; U.S. Army Corps of Engineers, 2008a–c) was used to determine water-surface profiles based on approximately bankfull-flow conditions. Hydraulic geometries, flows, and roughness coefficients (Manning's *n*) were used as input to the models. All hydraulic analyses in this investigation were based on computations of one-dimensional, steady, gradually varied flow. The analyses were also based on the assumption that flow is unobstructed in all stream channels and through all simulated hydraulic structures. The water-surface profiles for each stream were evaluated independently of the other streams.

Analyses of Open Channels

Abrupt changes in channel cross-section geometry and conveyance from one cross section to the next can result in inaccurate estimation of water-surface profiles because it is difficult to estimate associated energy losses. To help reduce the likelihood of abrupt changes in area and/or conveyance in the hydraulic analyses, the maximum distance between cross sections was limited to no more than 500 ft. Stream channel and overbank roughness coefficients (Manning's *n*) were estimated for all cross sections in the hydraulic models. The HEC-RAS default contraction- and expansion-loss coefficients, 0.1 and 0.3, respectively, were used for most of the cross sections in the models. At select locations, typically upstream and downstream from hydraulic structures and at abrupt changes in the stream channel cross-sectional area, default values for the contraction and expansion-loss coefficients were increased to as much as 0.4 and 0.6, respectively.

In general, the streams studied in the Chippewa Creek basin have a trapezoidal cross-section shape with bottom widths of 6–64 ft and a side slope generally in the range of 2:1–2.5:1. Although small streams frequently exhibit abrupt changes in cross-sectional area and conveyance, due to the channel modifications by the SCS, most reaches in the study area were straight and had gradually varying cross-sectional area.

Starting water-surface elevations for all streams were determined from a normal depth (slope conveyance) calculation in HEC-RAS. The main-channel slope used to compute the normal depth was determined from surveyed cross sections near the downstream limit of each stream reach and assumed to approximate the respective energy-grade-line slopes for the purposes of normal-depth calculations. Values of selected hydraulic parameters used in the hydraulic models are listed in table 3.

Table 5. Basin characteristics and approximate bankfull flow at various locations for selected streams in the Chippewa Creek basin.

[ft/mi, feet per mile; mi^2, square miles; ft^3/s, cubic feet per second]

Location	Drainage area (square miles)	Main-channel slope (feet per mile)	Storage area (percent)	Approximate bankfull flow (cubic feet per second)
Chippewa Creek				
Above State Route 162 / Wedgewood Road[1]	9.48	37.8	2.39	369
At inlet to Chippewa Lake[1]	14.8	29.3	2.27	507
Above Buck Creek	22.4	23.9	4.76	614
Above Westfield Ditch	26.3	20.7	4.31	694
Above Hubbard Creek	35.8	14.4	4.11	848
Above unnamed tributary	46.1	11.5	3.50	1,020
Above Steele Ditch	50.5	9.42	3.58	1,070
Above Fall Creek	65.8	8.27	2.85	1,330
Above Tommy Run	71.4	7.37	2.72	1,410
Above Little Chippewa Creek	80.2	6.42	2.59	1,520
Above River Styx	113	6.37	2.05	2,050
At Easton Gage (03116200)	146	6.06	2.41	2,440
Above Mill Creek	147	5.31	2.42	2,400
Above Red Run	155	4.97	2.39	2,490
Above Silver Creek	176	4.01	2.31	2,680
At mouth	188	3.16	2.48	2,710
River Styx				
Above tributary near Blake Road	6.03	70.4	3.68	265
Above tributary north of Interstate 76 / State Route 224	9.34	54.1	2.57	379
Above Greenwich Road	11.3	44.6	2.73	425
Above north tributary	12.3	37.3	2.51	448
Above Holmes Brook	14.6	35.5	2.64	506
Above Landis Ditch	24.9	25.5	1.95	763
At mouth	29.6	23.6	2.63	831
Little Chippewa Creek				
Above west tributary	23.4	6.54	0.63	680
Above south tributary	26.7	6.00	0.57	751
Above Whitman Ditch	28.2	5.50	0.59	772
At mouth	32.2	6.37	0.57	875

[1] Stream is named The Inlet at this location.

Analyses of Hydraulic Structures

Four methods for computing losses through bridges are available in HEC-RAS. The energy equation (standard-step method) is applicable to the widest range of hydraulic problems (U.S. Army Corps of Engineers, 2008b). The standard-step method performs computations at bridges basically as open-channel flow, except that adjustments are made to account for the cross-sectional area and wetted perimeter[1] within the bridge opening. For most bridges modeled in this study, the energy equation was used to account for energy losses because very few bridges were submerged.

By definition, pressure flow occurs when the water surface on the upstream side of a bridge equals or exceeds the low-chord elevation, a condition that can cause the bridge to function as a pressurized orifice. In these cases, pressure-flow computations are warranted for use in HEC-RAS simulation. The use of this type of solution was checked at all bridges in the hydraulic models where the water-surface elevation derived from the energy equation was found to be within 1.0 ft of the low-chord elevation of a bridge. Review of the HEC-RAS model output indicated that pressure-flow computations were not required.

When road overflow occurs at a culvert, HEC-RAS can use a weir-flow computation to determine the amount of flow passing over the road (U.S. Army Corps of Engineers, 2008c). The validity of the weir-flow computation must be checked by means of a submergence[2] test. The model default maximum submergence for weir flow is set to 0.95 (95 percent). For a weir-flow computation to be considered valid, the road embankment must be high enough to cause flow over the road to pass through critical depth[3]. If a weir flow computation is not valid, computations are based upon contracted open-channel flow. For situations where road grades are submerged, Shearman and others (1986) recommend abandoning culvert and weir hydraulics in favor of composite sections (the combination of the road and culvert cross-section geometries) to reflect pseudo-open-channel conditions.

Preliminary HEC-RAS simulation indicated that road overflow would occur at two locations: Chippewa Creek Road at river station 114,595 of the Chippewa Creek model and a private driveway at river station 32,680 of the River Styx model. A check for submergence was done at each location where road overflow occurred to assess the validity of the weir-flow calculation. The Chippewa Creek Road bridge was modeled by use of the standard step method, and it was submerged from backwater from Chippewa Lake; thus, weir flow was not possible. The road grade of the submerged private driveway was not elevated enough to provide sufficient fall for the default weir-flow calculation. The culvert at the private drive was removed and replaced with a composite section.

[1]Wetted perimeter is defined as the length of the line of intersection of the channel wetted surface with a cross-section plane normal to the direction flow (Chow, 1959).

[2]Submergence is defined as the ratio of the depth of water above the minimum weir elevation on the downstream side of a structure divided by the height of the energy grade line above the minimum weir elevation on the upstream side of a structure (U.S. Army Corps of Engineers, 2008c).

[3]Critical depth is the depth of flow at which the specific energy is a minimum for a given discharge (Chow, 1959).

Reduction of Roughness Coefficient Analysis

To analyze the impact of reducing the roughness in the main channel (for example, as might occur if channels were cleared of vegetation and brush) on the water-surface-elevation profiles, the roughness coefficients for the main channels were reduced by 5, 10, 15, and 20 percent from their base values. These reductions were made along the entire reaches of Chippewa Creek, River Styx, and Little Chippewa Creek, and were applied only to the main channel, not to overbank areas. Table 6 shows the average decrease in the water-surface elevation for each reduction percentage on Chippewa Creek, River Styx, and Little Chippewa Creek. It should be noted that the values in the tables are valid only when all downstream roughness coefficients are similarly reduced. For example, in table 6, a 20-percent reduction in the main channel roughness coefficient along Chippewa Creek from Frick Road to State Route 3 will only result in a 0.78-ft decrease in the water-surface elevation if the main-channel roughness is also reduced by 20 percent from the mouth to Frick Road. The water-surface elevation changes shown in these tables are for the discharges used in the models (see table 5).

Results of Hydraulic Analyses

Water-surface profiles corresponding to approximately bankfull discharges and for selected reductions in roughness coefficients are presented in tabular and graphical formats in Appendix 3. These profiles show the computed water-surface elevations as a function of distance from a reference location. Reach-averaged reductions in water-surface elevations ranged from 0.11 to 1.29 ft over the four roughness reduction scenarios. Selected results of the final hydraulic analyses done for this study before performance of the decreased roughness-coefficient scenarios are presented in Appendix 2.

The minimum channel elevations at each cross section and the hydraulic structures are shown in figures 3–1, 3–2, and 3–3. All elevations presented in the profile plots are referenced to the NAVD 88. The HEC-RAS model simulations indicated that road overflow would occur at two locations: the Chippewa Creek Road at river station 114,595 of the Chippewa Creek model and a private driveway at river station 32, 680 of the River Styx model (fig. 3–1 and 3–2, respectively). The Chippewa Creek Road bridge was submerged from backwater from Chippewa Lake.

Table 6. Average decrease in water-surface elevation, in feet, along the selected reach after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent from the base values.

Description of reach	Reach-averaged decrease in water-surface elevation (in feet) for indicated reduction in roughness coefficient (in percent) over the entire length of the main channel from the base values			
	5 percent	10 percent	15 percent	20 percent
Chippewa Creek				
Mouth to South Main Street	0.32	0.57	0.89	1.29
South Main Street to Frick Road	0.31	0.62	0.79	1.13
Frick Road to State Route 3 / West Main Street	0.19	0.39	0.55	0.78
State Route 3 / West Main Street to Interstate -76 / State Route 224	0.11	0.22	0.32	0.40
Interstate -76 / State Route 224 to Kennard Road	0.13	0.24	0.44	0.60
Kennard Road to upper limit	0.18	0.34	0.52	0.71
River Styx				
Mouth to low head dam	0.21	0.41	0.54	0.75
Low head dam to Interstate -76 / State Route 224	0.11	0.18	0.29	0.39
Interstate -76 / State Route 224 to Blake Road	0.11	0.21	0.31	0.39
Blake Road to upper limit	0.11	0.20	0.28	0.36
Little Chippewa Creek				
Mouth to private road	0.21	0.44	0.57	0.85
Private road to State Route 604 / Easton Road	0.23	0.47	0.61	0.89
State Route 604 / Easton Road to upper limit	0.23	0.47	0.59	0.85

Summary

The USGS, in cooperation with the Chippewa Subdistrict of the Muskingum Watershed Conservancy District, performed hydrologic and hydraulic analyses for selected reaches of three streams in Medina, Wayne, Stark, and Summit Counties in northeast Ohio: Chippewa Creek, Little Chippewa Creek, and River Styx. This study was done to facilitate assessment of various alternatives for mitigating flood hazards in the Chippewa Creek basin.

StreamStats regional regression equations were used to estimate instantaneous peak discharges approximately corresponding to bankfull flows. Explanatory variables used in the regression equations were drainage area, main-channel slope, and storage area. Hydraulic models were developed to determine water-surface profiles along the three stream reaches studied for the bankfull discharges established in the hydrologic analyses. The HEC-RAS step-backwater hydraulic analysis model was used to determine water-surface profiles for the three streams. Starting water-surface elevations for all streams were established using normal depth computations in the HEC-RAS models. Cross-sectional elevation data, hydraulic-structure geometries, and roughness coefficients were collected in the field and (along with peak-discharge estimates) used as input for the models. Reach-averaged reductions in water-surface elevations ranged from 0.11 to 1.29 feet over the four roughness coefficient reduction scenarios.

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Appendix 1. Descriptions of Benchmarks

14 CWL

Seville, 2.2 mi NW. of; 0.1 mi SE. of intersection of Interstate Highway 71; 460 ft S. of, and 2 ft lower than centerline of rd. opposite tree line E.; 84 ft N. and 33 ft. E. of centerline of rd. at junction of drive E. to residence of E.S. Paxon 87 ft. ENE. of centerline of B. & O. RR.; 3 ft. NW. of power pole; in concrete post; standard tablet stamped "14 CWL 1952 1008 TT"

Elev 1007.533 (NGVD 29) converted with Corpscon Elevation 1006.86 (NAVD 88)

23 EVB

Poe, 1.6 mi S. of, along State Highway 57; 1.7 mi. N. of Blake; 17 ft N. and 19 ft W. of, and 2 ft lower than centerline of rd opposite fenceline W.; 17 ft N. and 6 ft E. of pole; in W. concrete abutment of culvert; standard tablet stamped "23 EVB 1959 1188"

Elev 1188.186 (NGVD 29) converted with Corpscon Elevation 1187.54 (NAVD 88)

964

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1        National Geodetic Survey,   Retrieval Date = JULY 14, 2006
 KY1726 ***********************************************************************
 KY1726  DESIGNATION -  964
 KY1726  PID         -  KY1726
 KY1726  STATE/COUNTY-  OH/WAYNE
 KY1726  USGS QUAD   -  RITTMAN (1994)
 KY1726
 KY1726                        *CURRENT SURVEY CONTROL
 KY1726  ___________________________________________________________________
 KY1726* NAD 83(1986)-  40 57 56.     (N)    081 50 05.     (W)     SCALED
 KY1726* NAVD 88     -       294.065  (meters)     964.78   (feet)  ADJUSTED
 KY1726  ___________________________________________________________________
 KY1726  GEOID HEIGHT-         -33.19  (meters)                     GEOID03
 KY1726  DYNAMIC HT  -         293.935 (meters)     964.35  (feet)  COMP
 KY1726  MODELED GRAV-     980,174.9   (mgal)                       NAVD 88
 KY1726
 KY1726  VERT ORDER  -  FIRST     CLASS I
 KY1726
 KY1726.The horizontal coordinates were scaled from a topographic map and have
 KY1726.an estimated accuracy of +/- 6 seconds.
 KY1726
 KY1726.The orthometric height was determined by differential leveling
 KY1726.and adjusted by the National Geodetic Survey in June 1991.
 KY1726
 KY1726.The geoid height was determined by GEOID03.
 KY1726
 KY1726.The dynamic height is computed by dividing the NAVD 88
 KY1726.geopotential number by the normal gravity value computed on the
 KY1726.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KY1726.degrees latitude (g = 980.6199 gals.).
 KY1726
 KY1726.The modeled gravity was interpolated from observed gravity values.
 KY1726
 KY1726;                    North         East    Units  Estimated Accuracy
 KY1726;SPC OH N     -   144,450.      656,000.      MT  (+/- 180 meters Scaled)
 KY1726
 KY1726                          SUPERSEDED SURVEY CONTROL
 KY1726
 KY1726  NGVD 29 (??/??/92)  294.273  (m)          965.46   (f) ADJ UNCH    1 1
 KY1726
 KY1726.Superseded values are not recommended for survey control.
 KY1726.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 KY1726.See file dsdata.txt to determine how the superseded data were derived.
 KY1726
 KY1726_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF297352(NAD 83)
 KY1726_MARKER: DD = SURVEY DISK
 KY1726_SETTING: 36 = SET IN A MASSIVE STRUCTURE
 KY1726_SP_SET: BRIDGE
 KY1726_STAMPING: 964
 KY1726_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 KY1726
 KY1726  HISTORY     - Date     Condition        Report By
 KY1726  HISTORY     - UNK      MONUMENTED       USGS
 KY1726  HISTORY     - 1967     GOOD             NGS
 KY1726  HISTORY     - 1971     GOOD             OHDT
 KY1726  HISTORY     - 1987     GOOD             OHDT
 KY1726
 KY1726                          STATION DESCRIPTION
 KY1726
 KY1726'DESCRIBED BY NATIONAL GEODETIC SURVEY 1967
 KY1726'1.1 MI SE FROM STERLING.
 KY1726'ABOUT 1.1 MILES SOUTHEAST ALONG THE BALTIMORE AND OHIO RAILROAD
 KY1726'FROM THE CROSSING OF COUNTY ROAD NO. 60 AT STERLING, IN SECTION
 KY1726'9, R 12 W, T 18 N, BETWEEN THE BALTIMORE AND OHIO RAILROAD AND
 KY1726'THE ERIE-LACKAWANNA RAILROAD, NEAR B AND O RAILROAD MILEPOLE
 KY1726'154-32, 65 FEET WEST OF THE ERIE-LACKAWANNA RAILROAD MILEPOST
 KY1726'S 223, SET ON TOP OF THE SOUTHEAST END OF THE SOUTHWEST HEADWALL
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```
KY1726'OF A 36-FOOT CONCRETE BRIDGE UNDER THE ERIE-LACKAWANNA RAILROAD,
KY1726'46.3 FEET NORTHEAST OF THE NORTHEAST RAIL OF THE B AND O
KY1726'RAILROAD, 18 FEET SOUTHWEST OF THE SOUTHWEST RAIL OF THE
KY1726'ERIE-LACKAWANNA RAILROAD, 1 FOOT NORTHWEST OF THE SOUTHEAST
KY1726'END OF THE HEAD WALL AND ABOUT LEVEL WITH THE ERIE-LACKAWANNA
KY1726'RAILROAD.
KY1726
KY1726                          STATION RECOVERY (1971)
KY1726
KY1726'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1971
KY1726'RECOVERED IN GOOD CONDITION.
KY1726
KY1726                          STATION RECOVERY (1987)
KY1726
KY1726'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1987 (ROS)
KY1726'RECOVERED IN GOOD CONDITION.
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F 281

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1        National Geodetic Survey,   Retrieval Date = JULY 14, 2006
 KY1827 ***********************************************************************
 KY1827  DESIGNATION -  F 281
 KY1827  PID         -  KY1827
 KY1827  STATE/COUNTY-  OH/WAYNE
 KY1827  USGS QUAD   -  RITTMAN (1994)
 KY1827
 KY1827                        *CURRENT SURVEY CONTROL
 KY1827  ___________________________________________________________________
 KY1827* NAD 83(1986)-  40 56 47.     (N)    081 47 00.     (W)     SCALED
 KY1827* NAVD 88     -       301.082  (meters)     987.80   (feet)  ADJUSTED
 KY1827  ___________________________________________________________________
 KY1827  GEOID HEIGHT-         -33.14  (meters)                     GEOID03
 KY1827  DYNAMIC HT  -         300.950 (meters)     987.37  (feet)  COMP
 KY1827  MODELED GRAV-     980,178.3   (mgal)                       NAVD 88
 KY1827
 KY1827  VERT ORDER  -  SECOND    CLASS 0
 KY1827
 KY1827.The horizontal coordinates were scaled from a topographic map and have
 KY1827.an estimated accuracy of +/- 6 seconds.
 KY1827
 KY1827.The orthometric height was determined by differential leveling
 KY1827.and adjusted by the National Geodetic Survey in June 1991.
 KY1827
 KY1827.The geoid height was determined by GEOID03.
 KY1827
 KY1827.The dynamic height is computed by dividing the NAVD 88
 KY1827.geopotential number by the normal gravity value computed on the
 KY1827.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KY1827.degrees latitude (g = 980.6199 gals.).
 KY1827
 KY1827.The modeled gravity was interpolated from observed gravity values.
 KY1827
 KY1827;                    North         East    Units  Estimated Accuracy
 KY1827;SPC OH N     -   142,360.      660,340.      MT  (+/- 180 meters Scaled)
 KY1827
 KY1827                          SUPERSEDED SURVEY CONTROL
 KY1827
 KY1827  NGVD 29 (??/??/92)  301.338  (m)          988.64   (f) ADJ UNCH    2 0
 KY1827
 KY1827.Superseded values are not recommended for survey control.
 KY1827.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 KY1827.See file dsdata.txt to determine how the superseded data were derived.
 KY1827
 KY1827_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF340331(NAD 83)
 KY1827_MARKER: DB = BENCH MARK DISK
 KY1827_SETTING: 30 = SET IN A LIGHT STRUCTURE
 KY1827_SP_SET: CULVERT
 KY1827_STAMPING: F 281 1959
 KY1827_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
 KY1827
 KY1827  HISTORY     - Date     Condition        Report By
 KY1827  HISTORY     - 1959     MONUMENTED       CGS
 KY1827  HISTORY     - 1971     GOOD             OHDT
 KY1827  HISTORY     - 1987     GOOD             OHDT
 KY1827
 KY1827                          STATION DESCRIPTION
 KY1827
 KY1827'DESCRIBED BY COAST AND GEODETIC SURVEY 1959
 KY1827'1.5 MI S FROM RITTMAN.
 KY1827'ABOUT 1.5 MILES SOUTH ALONG STATE HIGHWAY 94 FROM THE BALTIMORE
 KY1827'AND OHIO RAILROAD STATION AT RITTMAN, 78 YARDS NORTH OF THE
 KY1827'INTERSECTION OF STATE HIGHWAY 604, 22 FEET WEST OF THE CENTER
 KY1827'LINE OF HIGHWAY 94, IN TOP OF THE SOUTH END OF THE WEST HEAD WALL
 KY1827'OF A 4-FOOT CONCRETE CULVERT, AND ABOUT 2 1/2 FEET BELOW THE
 KY1827'LEVEL OF THE HIGHWAY.
 KY1827
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KY1827                          STATION RECOVERY (1971)
KY1827
KY1827'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1971
KY1827'RECOVERED IN GOOD CONDITION.
KY1827
KY1827                          STATION RECOVERY (1987)
KY1827
KY1827'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1987 (ROS)
KY1827'RECOVERED IN GOOD CONDITION.
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H 281

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1        National Geodetic Survey,   Retrieval Date = JULY 14, 2006
 KY1829 ***********************************************************************
 KY1829  DESIGNATION -  H 281
 KY1829  PID         -  KY1829
 KY1829  STATE/COUNTY-  OH/WAYNE
 KY1829  USGS QUAD   -  RITTMAN (1994)
 KY1829
 KY1829                        *CURRENT SURVEY CONTROL
 KY1829  ___________________________________________________________________
 KY1829* NAD 83(1986)-  40 55 53.     (N)    081 46 52.     (W)     SCALED
 KY1829* NAVD 88     -       295.772  (meters)     970.38   (feet)  ADJUSTED
 KY1829  ___________________________________________________________________
 KY1829  GEOID HEIGHT-         -33.12  (meters)                     GEOID03
 KY1829  DYNAMIC HT  -         295.643 (meters)     969.96  (feet)  COMP
 KY1829  MODELED GRAV-     980,177.0   (mgal)                       NAVD 88
 KY1829
 KY1829  VERT ORDER  -  SECOND    CLASS 0
 KY1829
 KY1829.The horizontal coordinates were scaled from a topographic map and have
 KY1829.an estimated accuracy of +/- 6 seconds.
 KY1829
 KY1829.The orthometric height was determined by differential leveling
 KY1829.and adjusted by the National Geodetic Survey in June 1991.
 KY1829
 KY1829.The geoid height was determined by GEOID03.
 KY1829
 KY1829.The dynamic height is computed by dividing the NAVD 88
 KY1829.geopotential number by the normal gravity value computed on the
 KY1829.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KY1829.degrees latitude (g = 980.6199 gals.).
 KY1829
 KY1829.The modeled gravity was interpolated from observed gravity values.
 KY1829
 KY1829;                    North         East    Units  Estimated Accuracy
 KY1829;SPC OH N     -   140,690.      660,540.      MT  (+/- 180 meters Scaled)
 KY1829
 KY1829                          SUPERSEDED SURVEY CONTROL
 KY1829
 KY1829  NGVD 29 (??/??/92)  296.024  (m)          971.21   (f) ADJ UNCH    2 0
 KY1829
 KY1829.Superseded values are not recommended for survey control.
 KY1829.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 KY1829.See file dsdata.txt to determine how the superseded data were derived.
 KY1829
 KY1829_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF342314(NAD 83)
 KY1829_MARKER: DB = BENCH MARK DISK
 KY1829_SETTING: 36 = SET IN A MASSIVE STRUCTURE
 KY1829_SP_SET: ABUTMENT
 KY1829_STAMPING: H 281 1959
 KY1829_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 KY1829
 KY1829  HISTORY     - Date     Condition        Report By
 KY1829  HISTORY     - 1959     MONUMENTED       CGS
 KY1829  HISTORY     - 19870331 GOOD             OHDT
 KY1829
 KY1829                          STATION DESCRIPTION
 KY1829
 KY1829'DESCRIBED BY COAST AND GEODETIC SURVEY 1959
 KY1829'2.7 MI S FROM RITTMAN.
 KY1829'ABOUT 2.6 MILES SOUTH ALONG STATE HIGHWAY 94 FROM THE BALTIMORE
 KY1829'AND OHIO RAILROAD STATION AT RITTMAN, THENCE ABOUT 0.1 MILE
 KY1829'EAST ALONG ROAD 108, 11 FEET NORTH OF THE CENTER LINE OF ROAD
 KY1829'108, IN TOP OF THE NORTH END OF THE WEST ABUTMENT OF A 9-FOOT
 KY1829'CONCRETE BRIDGE OVER A CREEK BRANCH, AND ABOUT LEVEL WITH THE
 KY1829'ROAD.
 KY1829
 KY1829                          STATION RECOVERY (1987)
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KY1829
KY1829’RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1987 (ROS)
KY1829’RECOVERED IN GOOD CONDITION

R 176

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1        National Geodetic Survey,   Retrieval Date = SEPTEMBER 13, 2006
 MB1307 ***********************************************************************
 MB1307  DESIGNATION -  R 176
 MB1307  PID         -  MB1307
 MB1307  STATE/COUNTY-  OH/MEDINA
 MB1307  USGS QUAD   -  WESTFIELD CENTER (1994)
 MB1307
 MB1307                        *CURRENT SURVEY CONTROL
 MB1307  ___________________________________________________________________
 MB1307* NAD 83(1995)-  41 00 44.74391(N)    081 55 22.68128(W)     ADJUSTED
 MB1307* NAVD 88     -       309.300  (meters)    1014.76   (feet)  ADJUSTED
 MB1307  ___________________________________________________________________
 MB1307  X           -     677,216.109 (meters)                     COMP
 MB1307  Y           -  -4,772,080.521 (meters)                     COMP
 MB1307  Z           -   4,163,645.894 (meters)                     COMP
 MB1307  LAPLACE CORR-           1.14  (seconds)                    DEFLEC99
 MB1307  ELLIP HEIGHT-         275.95  (meters)          (10/07/05) GPS OBS
 MB1307  GEOID HEIGHT-         -33.31  (meters)                     GEOID03
 MB1307  DYNAMIC HT  -         309.163 (meters)    1014.31  (feet)  COMP
 MB1307  MODELED GRAV-     980,172.7   (mgal)                       NAVD 88
 MB1307
 MB1307  HORZ ORDER  -  FIRST
 MB1307  VERT ORDER  -  FIRST     CLASS I
 MB1307  ELLP ORDER  -  FOURTH    CLASS II
 MB1307
 MB1307.The horizontal coordinates were established by GPS observations
 MB1307.and adjusted by the TERRASURV in August 2003.
 MB1307
 MB1307.The orthometric height was determined by differential leveling
 MB1307.and adjusted by the National Geodetic Survey in June 1991.
 MB1307
 MB1307.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 MB1307
 MB1307.The Laplace correction was computed from DEFLEC99 derived deflections.
 MB1307
 MB1307.The ellipsoidal height was determined by GPS observations
 MB1307.and is referenced to NAD 83.
 MB1307
 MB1307.The geoid height was determined by GEOID03.
 MB1307
 MB1307.The dynamic height is computed by dividing the NAVD 88
 MB1307.geopotential number by the normal gravity value computed on the
 MB1307.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 MB1307.degrees latitude (g = 980.6199 gals.).
 MB1307
 MB1307.The modeled gravity was interpolated from observed gravity values.
 MB1307
 MB1307;                    North         East     Units Scale Factor Converg.
 MB1307;SPC OH N     -   149,601.845   648,536.370   MT  0.99993960   +0 22 44.7
 MB1307;UTM  17      - 4,540,547.004   422,391.171   MT  0.99967413   -0 36 20.5
 MB1307
 MB1307!             -  Elev Factor  x  Scale Factor =   Combined Factor
 MB1307!SPC OH N     -   0.99995672  x   0.99993960  =   0.99989632
 MB1307!UTM  17      -   0.99995672  x   0.99967413  =   0.99963086
 MB1307
 MB1307                         SUPERSEDED SURVEY CONTROL
 MB1307
 MB1307  ELLIP H (08/20/03)  275.97   (m)                       GP(       ) 4 2
 MB1307  NGVD 29 (??/??/92)  309.507  (m)         1015.44   (f) ADJ UNCH    1 1
 MB1307
 MB1307.Superseded values are not recommended for survey control.
 MB1307.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 MB1307.See file dsdata.txt to determine how the superseded data were derived.
 MB1307
 MB1307_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF2239140547(NAD 83)
 MB1307_MARKER: DB = BENCH MARK DISK
 MB1307_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
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MB1307_SP_SET: SET IN TOP OF CONCRETE MONUMENT
MB1307_STAMPING: R 176 1954
MB1307_MARK LOGO: NONE
MB1307_MAGNETIC: N = NO MAGNETIC MATERIAL
MB1307_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
MB1307+STABILITY: SURFACE MOTION
MB1307_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
MB1307+SATELLITE: SATELLITE OBSERVATIONS - 2000
MB1307
MB1307  HISTORY     - Date     Condition        Report By
MB1307  HISTORY     - 1954     MONUMENTED       CGS
MB1307  HISTORY     - 1967     GOOD             NGS
MB1307  HISTORY     - 1987     GOOD             USPSQD
MB1307  HISTORY     - 2000     GOOD             OH-103
MB1307
MB1307                          STATION DESCRIPTION
MB1307
MB1307'DESCRIBED BY NATIONAL GEODETIC SURVEY 1967
MB1307'4.4 MI N FROM CRESTON.
MB1307'ABOUT 2.8 MILES NORTHWEST ALONG THE BALTIMORE AND OHIO RAILROAD
MB1307'FROM THE CROSSING OF STATE HIGHWAY 3 AT CRESTON, THENCE 0.6
MB1307'MILE NORTH ALONG COUNTY ROAD NO. 15, THENCE 0.95 MILE EAST ALONG
MB1307'COUNTY ROAD NO. 46, AT THE WESTFIELD AIRPORT, 113 FEET NORTH OF
MB1307'THE CENTER LINE OF THE COUNTY ROAD, 110 FEET WEST OF THE
MB1307'SOUTHWEST CORNER OF THE TWO-STORIED PORTION OF A WHITE HOUSE,
MB1307'46.2 FEET NORTH OF THE NORTHEAST CORNER OF A CONCRETE BLOCK HANGAR
MB1307'BUILDING, 2 1/2 FEET SOUTHWEST OF THE SOUTHWEST CORNER OF A CONCRETE
MB1307'BASE WHICH FORMERLY SUPPORTED GAS PUMPS, 5 FEET ABOVE THE LEVEL OF THE
MB1307'ROAD AND SET IN THE TOP OF A CONCRETE POST PROJECTING 0.1 FOOT ABOVE
MB1307'THE LEVEL OF THE GROUND.
MB1307
MB1307                          STATION RECOVERY (1987)
MB1307
MB1307'RECOVERY NOTE BY US POWER SQUADRON 1987 (ROS)
MB1307'RECOVERED IN GOOD CONDITION.
MB1307
MB1307                          STATION RECOVERY (2000)
MB1307
MB1307'RECOVERY NOTE BY MEDINA COUNTY OHIO 2000
MB1307'RECOVERY NOTE BY MEDINA COUNTY SANITARY ENGINEER 2000
MB1307'FOUND IN GOOD CONDITION.
MB1307'
MB1307'PROPERTY IS NO LONGER AN ACTIVE AIRPORT AND IS NOW A PRIVATE
MB1307'RESIDENCE.
MB1307'
MB1307'
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M 176

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1        National Geodetic Survey,   Retrieval Date = SEPTEMBER 13, 2006
 MB1317 ***********************************************************************
 MB1317  CBN         -  This is a Cooperative Base Network Control Station.
 MB1317  DESIGNATION -  M 176
 MB1317  PID         -  MB1317
 MB1317  STATE/COUNTY-  OH/MEDINA
 MB1317  USGS QUAD   -  WESTFIELD CENTER (1994)
 MB1317
 MB1317                        *CURRENT SURVEY CONTROL
 MB1317  ___________________________________________________________________
 MB1317* NAD 83(1995)-  41 03 13.21094(N)    081 59 11.33577(W)     ADJUSTED
 MB1317* NAVD 88     -       344.920  (meters)    1131.62   (feet)  ADJUSTED
 MB1317  ___________________________________________________________________
 MB1317  X           -     671,510.171 (meters)                     COMP
 MB1317  Y           -  -4,769,877.345 (meters)                     COMP
 MB1317  Z           -   4,167,124.202 (meters)                     COMP
 MB1317  LAPLACE CORR-           2.02  (seconds)                    DEFLEC99
 MB1317  ELLIP HEIGHT-         311.48  (meters)          (03/08/05) GPS OBS
 MB1317  GEOID HEIGHT-         -33.44  (meters)                     GEOID03
 MB1317  DYNAMIC HT  -         344.770 (meters)    1131.13  (feet)  COMP
 MB1317  MODELED GRAV-     980,176.9   (mgal)                       NAVD 88
 MB1317
 MB1317  HORZ ORDER  -  B
 MB1317  VERT ORDER  -  FIRST     CLASS I
 MB1317  ELLP ORDER  -  FOURTH    CLASS II
 MB1317
 MB1317.The horizontal coordinates were established by GPS observations
 MB1317.and adjusted by the National Geodetic Survey in August 1996.
 MB1317
 MB1317.The orthometric height was determined by differential leveling
 MB1317.and adjusted by the National Geodetic Survey in June 1991.
 MB1317
 MB1317.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 MB1317
 MB1317.The Laplace correction was computed from DEFLEC99 derived deflections.
 MB1317
 MB1317.The ellipsoidal height was determined by GPS observations
 MB1317.and is referenced to NAD 83.
 MB1317
 MB1317.The geoid height was determined by GEOID03.
 MB1317
 MB1317.The dynamic height is computed by dividing the NAVD 88
 MB1317.geopotential number by the normal gravity value computed on the
 MB1317.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 MB1317.degrees latitude (g = 980.6199 gals.).
 MB1317
 MB1317.The modeled gravity was interpolated from observed gravity values.
 MB1317
 MB1317;                    North         East     Units Scale Factor Converg.
 MB1317;SPC OH N     -   154,148.069   643,166.978   MT  0.99993917   +0 20 14.5
 MB1317;UTM  17      - 4,545,183.656   417,102.103   MT  0.99968458   -0 38 52.5
 MB1317
 MB1317!             -  Elev Factor  x  Scale Factor =   Combined Factor
 MB1317!SPC OH N     -   0.99995114  x   0.99993917  =   0.99989032
 MB1317!UTM  17      -   0.99995114  x   0.99968458  =   0.99963574
 MB1317
 MB1317                         SUPERSEDED SURVEY CONTROL
 MB1317
 MB1317  ELLIP H (08/20/96)  311.47   (m)                       GP(       ) 4 2
 MB1317  NAD 83(1986)-  41 03 13.21405(N)    081 59 11.33673(W) AD(       ) 3
 MB1317  NAD 27      -  41 03 13.01910(N)    081 59 11.83876(W) AD(       ) 3
 MB1317  NGVD 29 (??/??/92)  345.138  (m)         1132.34   (f) ADJ UNCH    1 1
 MB1317
 MB1317.Superseded values are not recommended for survey control.
 MB1317.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 MB1317.See file dsdata.txt to determine how the superseded data were derived.
 MB1317
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MB1317_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF1710245184(NAD 83)
MB1317_MARKER: DB = BENCH MARK DISK
MB1317_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
MB1317_SP_SET: SQUARE CONCRETE MONUMENT
MB1317_STAMPING: M 176 1954
MB1317_MARK LOGO: CGS
MB1317_MAGNETIC: N = NO MAGNETIC MATERIAL
MB1317_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
MB1317+STABILITY: SURFACE MOTION
MB1317_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
MB1317+SATELLITE: SATELLITE OBSERVATIONS - 2000
MB1317
MB1317  HISTORY     - Date     Condition        Report By
MB1317  HISTORY     - 1954     MONUMENTED       CGS
MB1317  HISTORY     - 1967     GOOD             NGS
MB1317  HISTORY     - 1986     GOOD             NGS
MB1317  HISTORY     - 1987     GOOD             USPSQD
MB1317  HISTORY     - 19950724 GOOD             NGS
MB1317  HISTORY     - 19980323 GOOD             GCS
MB1317  HISTORY     - 2000     GOOD             OH-103
MB1317
MB1317                          STATION DESCRIPTION
MB1317
MB1317'DESCRIBED BY NATIONAL GEODETIC SURVEY 1967
MB1317'1.9 MI NE FROM LODI.
MB1317'ABOUT 1.9 MILES NORTHEAST ALONG STATE HIGHWAY 421 AND U.S.
MB1317'HIGHWAY 42 FROM THE INTERSECTION OF STATE HIGHWAY 76 AT LODI,
MB1317'ABOUT 0.6 MILE NORTHEAST ALONG U.S. HIGHWAY 42 FROM THE NORTHEAST
MB1317'END OF THE U.S. HIGHWAY 224 OVERPASS, NEAR THE NORTHWEST CORNER
MB1317'OF THE LODI AIRPORT, 72 FEET EAST OF THE INTERSECTION OF U.S.
MB1317'HIGHWAY 42 AND TOWNSHIP ROAD NO. 78, 30 FEET SOUTHEAST OF THE
MB1317'CENTER LINE OF THE HIGHWAY, 30 1/2 FEET NORTH OF THE CENTER LINE
MB1317'OF TOWNSHIP ROAD NO. 78, 9 FEET NORTHEAST OF A GAS LINE MARKER
MB1317'NO. RDI 989S, 1.1 FEET NORTHEAST OF A METAL WITNESS POST, 2 FEET
MB1317'BELOW THE LEVEL OF THE HIGHWAY, SET IN THE TOP OF A CONCRETE POST
MB1317'0.2 FOOT UNDERGROUND.
MB1317
MB1317                          STATION RECOVERY (1986)
MB1317
MB1317'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1986
MB1317'STATION IS LOCATED ABOUT 2 MILES NORTHEAST OF LODI, 5 MILES WEST
MB1317'NORTHWEST OF THE JUNCTION OF INTERSTATE HIGHWAYS 76 AND 71, AT A ROAD
MB1317'JUNCTION, ON HIGHWAY RIGHT-OF-WAY.  OWNERSHIP  OHIO DEPARTMENT OF
MB1317'TRANSPORTATION.
MB1317'TO REACH FROM THE JUNCTION OF US HIGHWAYS 42 AND 224 AT THE NORTHWEST
MB1317'EDGE OF LODI, GO NORTHEAST ON HIGHWAY 42 FOR 0.7 MILES TO A SLANTED
MB1317'CROSSROAD AND STATION ON THE RIGHT.
MB1317'STATION MARK IS A STANDARD CGS BENCH MARK DISK STAMPED --M 176 1954--
MB1317'SET IN THE TOP OF A 25 CM SQUARE CONCRETE POST 0.4 METER BELOW GROUND
MB1317'(AREA IS VERY UNEVEN TO DITCHING AND PIPELINE).  IT IS 9.2 METERS
MB1317'SOUTHEAST OF THE CENTER OF HIGHWAY 42, 9.8 METERS NORTH OF THE
MB1317'CENTER OF COUNTY ROUT 78, 5.6 METERS WEST OF UTILITY POLE 65CR/4-12,
MB1317'3.7 METERS EAST OF A UTILITY POLE WITH STEPS, 4.2 METERS NORTHWEST
MB1317'OF THE SOUTHWEST ONE OF TWO PIPELINE WARNING POLES, AND 0.3 METER
MB1317'NORTHEAST OF A METAL WITNESS POLE.
MB1317'DESCRIBED BY G R HEID.
MB1317'TYPED BY JAMES MALONEY 9/09/87.
MB1317
MB1317                          STATION RECOVERY (1987)
MB1317
MB1317'RECOVERY NOTE BY US POWER SQUADRON 1987 (ROS)
MB1317'RECOVERED IN GOOD CONDITION.
MB1317
MB1317                          STATION RECOVERY (1995)
MB1317
MB1317'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1995 (AJL)
MB1317'THE STATION IS LOCATED ABOUT 3.2 KM (2.00 MI) NORTHEAST OF LODI, 8.0
MB1317'KM (4.95 MI) WEST NORTHWEST OF THE JUNCTION OF INTERSTATE HIGHWAYS 76
MB1317'AND 71, ON HIGHWAY RIGHT-OF-WAY AT THE JUNCTION OF U S HIGHWAY 42 AND
MB1317'KENNARD ROAD.  TO REACH FROM THE JUNCTION OF U S HIGHWAYS 224 AND 42
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MB1317'AT THE NORTHEAST EDGE OF LODI, GO NORTHEAST ON HIGHWAY 42 FOR 1.1 KM
MB1317'(0.70 MI) TO KENNARD ROAD AND THE STATION ON THE RIGHT.  THE STATION
MB1317'IS 9.2 M (30.2 FT) SOUTHEAST OF THE CENTER OF HIGHWAY 42, 10.1 M (33.1
MB1317'FT) NORTH OF THE CENTER OF KENNARD ROAD, 5.2 M (17.1 FT) NORTH OF A
MB1317'STOP SIGN, 5.6 M (18.4 FT) WEST OF UTILITY POLE NUMBER 65CR/4-12, 3.7
MB1317'M (12.1 FT) EAST OF ANOTHER UTILITY POLE, 0.6 M (2.0 FT) SOUTHEAST OF
MB1317'A FIBERGLASS WITNESS POST, AND RECESSED 0.3 M (1.0 FT) BELOW GROUND.
MB1317
MB1317                          STATION RECOVERY (1998)
MB1317
MB1317'RECOVERY NOTE BY GEODETIC CONSULTING SERVICES 1998 (KDZ)
MB1317'RECOVERED AS DESCRIBED.
MB1317
MB1317                          STATION RECOVERY (2000)
MB1317
MB1317'RECOVERY NOTE BY MEDINA COUNTY OHIO 2000
MB1317'RECOVERY NOTE BY MEDINA COUNTY SANITARY ENGINEER 2001
MB1317'FOUND AS DESCRIBED IN GOOD CONDITION.
MB1317'
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E 281

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1        National Geodetic Survey,   Retrieval Date = JULY 14, 2006
 KY1826 ***********************************************************************
 KY1826  DESIGNATION -  E 281
 KY1826  PID         -  KY1826
 KY1826  STATE/COUNTY-  OH/WAYNE
 KY1826  USGS QUAD   -  RITTMAN (1994)
 KY1826
 KY1826                        *CURRENT SURVEY CONTROL
 KY1826  ___________________________________________________________________
 KY1826* NAD 83(1995)-  40 57 30.01123(N)    081 46 49.27642(W)     ADJUSTED
 KY1826* NAVD 88     -       293.613  (meters)     963.30   (feet)  ADJUSTED
 KY1826  ___________________________________________________________________
 KY1826  X           -     689,653.610 (meters)                     COMP
 KY1826  Y           -  -4,774,268.115 (meters)                     COMP
 KY1826  Z           -   4,159,100.872 (meters)                     COMP
 KY1826  LAPLACE CORR-           0.30  (seconds)                    DEFLEC99
 KY1826  ELLIP HEIGHT-         260.45  (meters)          (10/07/05) GPS OBS
 KY1826  GEOID HEIGHT-         -33.16  (meters)                     GEOID03
 KY1826  DYNAMIC HT  -         293.485 (meters)     962.88  (feet)  COMP
 KY1826  MODELED GRAV-     980,179.5   (mgal)                       NAVD 88
 KY1826
 KY1826  HORZ ORDER  -  FIRST
 KY1826  VERT ORDER  -  SECOND    CLASS 0
 KY1826  ELLP ORDER  -  FOURTH    CLASS I
 KY1826
 KY1826.The horizontal coordinates were established by GPS observations
 KY1826.and adjusted by the National Geodetic Survey in October 2000.
 KY1826
 KY1826.The orthometric height was determined by differential leveling
 KY1826.and adjusted by the National Geodetic Survey in June 1991.
 KY1826
 KY1826.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 KY1826
 KY1826.The Laplace correction was computed from DEFLEC99 derived deflections.
 KY1826
 KY1826.The ellipsoidal height was determined by GPS observations
 KY1826.and is referenced to NAD 83.
 KY1826
 KY1826.The geoid height was determined by GEOID03.
 KY1826
 KY1826.The dynamic height is computed by dividing the NAVD 88
 KY1826.geopotential number by the normal gravity value computed on the
 KY1826.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KY1826.degrees latitude (g = 980.6199 gals.).
 KY1826
 KY1826.The modeled gravity was interpolated from observed gravity values.
 KY1826
 KY1826;                    North         East     Units Scale Factor Converg.
 KY1826;SPC OH N     -   143,684.424   660,581.348   MT  0.99994095   +0 28 22.0
 KY1826;UTM  17      - 4,534,425.189   434,329.388   MT  0.99965308   -0 30 41.6
 KY1826
 KY1826!             -  Elev Factor  x  Scale Factor =   Combined Factor
 KY1826!SPC OH N     -   0.99995915  x   0.99994095  =   0.99990010
 KY1826!UTM  17      -   0.99995915  x   0.99965308  =   0.99961224
 KY1826
 KY1826                         SUPERSEDED SURVEY CONTROL
 KY1826
 KY1826  ELLIP H (10/25/00)  260.44   (m)                       GP(       ) 4 1
 KY1826  NAVD 88 (10/25/00)  293.61   (m)          963.3    (f) LEVELING    3
 KY1826  NGVD 29 (??/??/92)  293.874  (m)          964.15   (f) ADJ UNCH    2 0
 KY1826
 KY1826.Superseded values are not recommended for survey control.
 KY1826.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 KY1826.See file dsdata.txt to determine how the superseded data were derived.
 KY1826
 KY1826_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF3432934425(NAD 83)
 KY1826_MARKER: DB = BENCH MARK DISK
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KY1826_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
KY1826_SP_SET: SET IN TOP OF CONCRETE MONUMENT
KY1826_STAMPING: E 281 1959
KY1826_MARK LOGO: CGS
KY1826_MAGNETIC: N = NO MAGNETIC MATERIAL
KY1826_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
KY1826+STABILITY: SURFACE MOTION
KY1826_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
KY1826+SATELLITE: SATELLITE OBSERVATIONS - March 23, 1998
KY1826
KY1826  HISTORY     - Date     Condition        Report By
KY1826  HISTORY     - 1959     MONUMENTED       CGS
KY1826  HISTORY     - 1971     GOOD             OHDT
KY1826  HISTORY     - 1987     GOOD             OHDT
KY1826  HISTORY     - 19980323 GOOD             GCS
KY1826
KY1826                          STATION DESCRIPTION
KY1826
KY1826'DESCRIBED BY COAST AND GEODETIC SURVEY 1959
KY1826'0.6 MI S FROM RITTMAN.
KY1826'ABOUT 0.65 MILE SOUTH ALONG STATE HIGHWAY 94 FROM THE BALTIMORE
KY1826'AND OHIO RAILROAD STATION AT RITTMAN, 0.25 MILE SOUTH OF THE
KY1826'SOUTH ONE OF TWO CONCRETE BRIDGES, 31 FEET EAST OF THE CENTER
KY1826'LINE OF THE HIGHWAY AND AT THE OUTSIDE OF A CURVE WITH TANGENTS
KY1826'EXTENDING NORTHEAST AND SOUTH, 94 FEET NORTH OF THE NORTH END OF
KY1826'EAST CONCRETE HEAD WALL OF A 24-INCH PIPE CULVERT, 20 1/2 FEET
KY1826'SOUTH OF A FENCE CORNER, 2 FEET WEST OF A WIRE FENCE, 23 FEET
KY1826'SOUTH OF A TELEPHONE POLE, ABOUT 1 1/2 FEET ABOVE THE LEVEL OF
KY1826'THE HIGHWAY, AND SET IN TOP OF A CONCRETE POST PROJECTING 3 INCHES.
KY1826
KY1826                          STATION RECOVERY (1971)
KY1826
KY1826'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1971
KY1826'RECOVERED IN GOOD CONDITION.
KY1826
KY1826                          STATION RECOVERY (1987)
KY1826
KY1826'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1987 (ROS)
KY1826'RECOVERED IN GOOD CONDITION.
KY1826
KY1826                          STATION RECOVERY (1998)
KY1826
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CHIP

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1        National Geodetic Survey,   Retrieval Date = JULY 14, 2006
 KY1839 ***********************************************************************
 KY1839  DESIGNATION -  CHIP
 KY1839  PID         -  KY1839
 KY1839  STATE/COUNTY-  OH/WAYNE
 KY1839  USGS QUAD   -  RITTMAN (1994)
 KY1839
 KY1839                        *CURRENT SURVEY CONTROL
 KY1839  ___________________________________________________________________
 KY1839* NAD 83(1995)-  40 53 05.52070(N)    081 45 47.09910(W)     ADJUSTED
 KY1839* NAVD 88     -       342.153  (meters)    1122.55   (feet)  ADJUSTED
 KY1839  ___________________________________________________________________
 KY1839  X           -     691,863.719 (meters)                     COMP
 KY1839  Y           -  -4,779,385.822 (meters)                     COMP
 KY1839  Z           -   4,152,967.483 (meters)                     COMP
 KY1839  LAPLACE CORR-           0.23  (seconds)                    DEFLEC99
 KY1839  ELLIP HEIGHT-         309.09  (meters)          (10/07/05) GPS OBS
 KY1839  GEOID HEIGHT-         -33.05  (meters)                     GEOID03
 KY1839  DYNAMIC HT  -         342.002 (meters)    1122.05  (feet)  COMP
 KY1839  MODELED GRAV-     980,173.5   (mgal)                       NAVD 88
 KY1839
 KY1839  HORZ ORDER  -  FIRST
 KY1839  VERT ORDER  -  SECOND    CLASS 0
 KY1839  ELLP ORDER  -  FOURTH    CLASS I
 KY1839
 KY1839.The horizontal coordinates were established by GPS observations
 KY1839.and adjusted by the National Geodetic Survey in October 2000.
 KY1839
 KY1839.The orthometric height was determined by differential leveling
 KY1839.and adjusted by the National Geodetic Survey in June 1991.
 KY1839
 KY1839.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 KY1839
 KY1839.The Laplace correction was computed from DEFLEC99 derived deflections.
 KY1839
 KY1839.The ellipsoidal height was determined by GPS observations
 KY1839.and is referenced to NAD 83.
 KY1839
 KY1839.The geoid height was determined by GEOID03.
 KY1839
 KY1839.The dynamic height is computed by dividing the NAVD 88
 KY1839.geopotential number by the normal gravity value computed on the
 KY1839.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KY1839.degrees latitude (g = 980.6199 gals.).
 KY1839
 KY1839.The modeled gravity was interpolated from observed gravity values.
 KY1839
 KY1839;                    North         East     Units Scale Factor Converg.
 KY1839;SPC OH N     -   135,538.352   662,104.199   MT  0.99994421   +0 29 02.8
 KY1839;UTM  17      - 4,526,256.541   435,711.724   MT  0.99965087   -0 29 58.2
 KY1839
 KY1839!             -  Elev Factor  x  Scale Factor =   Combined Factor
 KY1839!SPC OH N     -   0.99995152  x   0.99994421  =   0.99989573
 KY1839!UTM  17      -   0.99995152  x   0.99965087  =   0.99960240
 KY1839
 KY1839|-------------------------------------------------------------------|
 KY1839| PID    Reference Object                    Distance      Geod. Az  |
 KY1839|                                                          dddmmss.s |
 KY1839| KY1838 CHIP RM 1                            7.452 METERS 00404     |
 KY1839| KY3464 DALTON MUN STANDPIPE                APPROX.10.7 KM 1535747.4 |
 KY1839| KY1840 CHIP RM 2                            7.699 METERS 17610     |
 KY1839| KY3494 ORRVILLE MUN LT WATER PLT STK       APPROX. 3.8 KM 1830730.2 |
 KY1839| KY3493 ORRVILLE MUNICIPAL TANK             APPROX. 4.9 KM 1832139.5 |
 KY1839| KY3492 ORRVILLE MILK CO STACK              APPROX. 5.6 KM 1922113.3 |
 KY1839| KY1836 CHIP AZ MK                                        3583209.9 |
 KY1839|-------------------------------------------------------------------|
 KY1839
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KY1839                          SUPERSEDED SURVEY CONTROL
KY1839
KY1839  ELLIP H (10/25/00)  309.10   (m)                       GP(       ) 4 1
KY1839  NAD 83(1995)-  40 53 05.51978(N)    081 45 47.09676(W) AD(       ) 3
KY1839  NAD 83(1986)-  40 53 05.52935(N)    081 45 47.10207(W) AD(       ) 3
KY1839  NAD 27      -  40 53 05.32232(N)    081 45 47.62804(W) AD(       ) 3
KY1839  NAVD 88 (10/25/00)  342.15   (m)         1122.5    (f) LEVELING    3
KY1839  NGVD 29 (??/??/92)  342.386  (m)         1123.31   (f) ADJ UNCH    2 0
KY1839
KY1839.Superseded values are not recommended for survey control.
KY1839.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
KY1839.See file dsdata.txt to determine how the superseded data were derived.
KY1839
KY1839_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF3571226257(NAD 83)
KY1839_MARKER: DS = TRIANGULATION STATION DISK
KY1839_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
KY1839_SP_SET: SET IN TOP OF CONCRETE MONUMENT
KY1839_STAMPING: CHIP 1959
KY1839_MARK LOGO: CGS
KY1839_MAGNETIC: N = NO MAGNETIC MATERIAL
KY1839_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
KY1839+STABILITY: SURFACE MOTION
KY1839_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
KY1839+SATELLITE: SATELLITE OBSERVATIONS - March 23, 1998
KY1839
KY1839  HISTORY     - Date     Condition        Report By
KY1839  HISTORY     - 1959     MONUMENTED       CGS
KY1839  HISTORY     - 1959     GOOD             CGS
KY1839  HISTORY     - 1971     GOOD             OHDT
KY1839  HISTORY     - 1971     GOOD             OHDT
KY1839  HISTORY     - 1988     GOOD             OHDT
KY1839  HISTORY     - 19980323 GOOD             GCS
KY1839
KY1839                          STATION DESCRIPTION
KY1839
KY1839'DESCRIBED BY COAST AND GEODETIC SURVEY 1959 (WER)
KY1839'THE STATION IS ABOUT 3 MILES NORTH ORRVILLE, 1-1/2 MILES SOUTHWEST OF
KY1839'MARSHALLVILLE, ON THE EAST
KY1839'RIGHT-OF-WAY OF STATE HIGHWAY 94, IN BAUGHMAN TOWNSHIP, IN SECTION
KY1839'7, T-17-N AND R-11-W.
KY1839'
KY1839'TO REACH THE STATION FROM THE INTERSECTION OF MAIN STREET AND MARKET
KY1839'STREET IN ORRVILLE, GO
KY1839'NORTH ON STATE HIGHWAY 94 FOR 3.1 MILES TO THE STATION ON THE RIGHT.
KY1839'
KY1839'STATION MARKS ARE STANDARD DISKS STAMPED CHIP 1959.  THE SURFACE DISK
KY1839'IS SET IN A SQUARE CONCRETE POST
KY1839'FLUSH WITH THE SURFACE OF THE GROUND.  IT IS 215 FEET NORTHEAST OF
KY1839'THE DRIVEWAY ENTRANCE TO THE HOME OF MR. WILLARD J.
KY1839'YEAKLEY, 28 FEET EAST OF THE CENTER LINE OF HIGHWAY 94, 9 FEET NORTH
KY1839'OF A POWERLINE POLE FOURTH POLE NORTH OF A FARM
KY1839'HOUSE AND 2 FEET WEST OF THE RIGHT-OF-WAY FENCELINE.
KY1839'A STANDARD WITNESS POST WAS SET 3.3 FEET NORTHEAST OF THE
KY1839'MARK.  THE UNDERGROUND DISK IS SET IN AN
KY1839'IRREGULAR MASS OF CONCRETE 32 INCHES BELOW THE SURFACE OF THE GROUND.
KY1839'
KY1839'REFERENCE MARK NO. 1, A STANDARD DISK STAMPED CHIP NO 1 1959, IS SET
KY1839'IN A SQUARE CONCRETE POST
KY1839'WHICH PROJECTS 2 INCHES.  IT IS 33 FEET NORTH OF THE POWERLINE POLE,
KY1839'29 FEET EAST OF THE CENTER LINE OF
KY1839'HIGHWAY AND 1 FOOT WEST OF THE RIGHT-OF-WAY FENCELINE.
KY1839'
KY1839'REFERENCE MARK NO. 2, A STANDARD DISK STAMPED CHIP NO 2 1959, IS SET
KY1839'IN A SQUARE CONCRETE POST
KY1839'WHICH PROJECTS 2 INCHES.  IT IS 190 FEET NORTHEAST OF THE DRIVEWAY,
KY1839'30 FEET EAST OF THE CENTER LINE
KY1839'OF HIGHWAY, 17 FEET SOUTH OF THE POWERLINE POLE AND 1
KY1839'FOOT WEST OF THE RIGHT-OF-WAY FENCELINE.
KY1839'
KY1839'AZIMUTH MARK, A STANDARD DISK STAMPED CHIP 1959, IS SET IN A SQUARE
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KY1839'CONCRETE POST WHICH PROJECTS 4
KY1839'INCHES.  IT IS 238 FEET SOUTH OF THE CENTERLINE OF A DRIVEWAY
KY1839'ENTRANCE, 40 FEET EAST OF THE
KY1839'CENTERLINE OF HIGHWAY 94 AND 2 FEET SOUTH OF THE POWERLINE POLE
KY1839'WHICH IS THE SIXTH POLE NORTH OF THE
KY1839'JUNCTION OF HIGHWAY 94 AND TOWNSHIP ROAD 221.  A
KY1839'STANDARD WITNESS POST WAS SET 1.6 FEET NORTHEAST OF THE
KY1839'MARK.
KY1839'
KY1839'TO REACH THE AZIMUTH MARK FROM THE STATION, GO NORTH ON HIGHWAY 94
KY1839'FOR 0.3 MILE TO THE MARK ON
KY1839'THE LEFT.
KY1839
KY1839                          STATION RECOVERY (1959)
KY1839
KY1839'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1959
KY1839'3 MI N FROM ORRVILLE.
KY1839'ABOUT 3.0 MILES NORTH ALONG STATE HIGHWAY 94 FROM THE LIBRARY
KY1839'AT ORRVILLE, 0.25 MILE SOUTH OF THE JUNCTION OF ROAD 221 LEADING
KY1839'EAST, 0.2 MILE SOUTH OF THE JUNCTION OF ROAD 221 LEADING WEST,
KY1839'50 YARDS NORTH OF THE TOP OF GRADE, 27 1/2 FEET EAST OF THE
KY1839'CENTER LINE OF HIGHWAY 94, 2 1/2 FEET WEST OF A WIRE FENCE, 8 1/2
KY1839'FEET NORTH OF A POWER LINE POLE, 25.2 FEET NORTH OF R M 2, 24.4
KY1839'FEET SOUTH OF R M 1, 3.3 FEET SOUTHWEST OF A STEEL WITNESS
KY1839'POST, AND ABOUT 3 FEET ABOVE THE LEVEL OF THE HIGHWAY, AND SET
KY1839'IN TOP OF A CONCRETE POST FLUSH WITH THE GROUND.
KY1839
KY1839                          STATION RECOVERY (1971)
KY1839
KY1839'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1971 (WHC)
KY1839'CHIP, CHIP R.M. NO. 1 AND R.M. NO. 2 RECOVERED GOOD.
KY1839'
KY1839'CHIP AZI RECOVERED GOOD.
KY1839'
KY1839'DISTANCE AND DIRECTION FROM NEAREST TOWN--ABOUT 3 MILES NORTH ALONG
KY1839'SR 57 FROM LIBRARY AT ORRVILLE.
KY1839
KY1839                          STATION RECOVERY (1971)
KY1839
KY1839'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1971 (RS)
KY1839'CHIP 1959 RECOVERED GOOD - HAS WITNESS.
KY1839'
KY1839'CHIP NO. 1-1959 RECOVERED GOOD - NO WITNESS.
KY1839'
KY1839'CHIP NO. 2-1959 RECOVERED GOOD - NO WITNESS.
KY1839'
KY1839'AZI. CHIP-1959 RECOVERED GOOD - HAS WITNESS.
KY1839'
KY1839'DESCRIPTION IS ACCURATE EXCEPT ROUTE 94 IS NOW ROUTE 57.
KY1839'
KY1839'DISTANCE AND DIRECTION FROM NEAREST TOWN--3 MILES + OR - NORTH OF
KY1839'ORRVILLE.
KY1839
KY1839                          STATION RECOVERY (1988)
KY1839
KY1839'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1988 (ROS)
KY1839'RECOVERED IN GOOD CONDITION.
KY1839
KY1839                          STATION RECOVERY (1998)
KY1839
KY1839'RECOVERY NOTE BY GEODETIC CONSULTING SERVICES 1998 (KDZ)
KY1839'RECOVERED AS DESCRIBED.
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N 177

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1        National Geodetic Survey,   Retrieval Date = JULY 14, 2006
 KY1710 ***********************************************************************
 KY1710  DESIGNATION -  N 177
 KY1710  PID         -  KY1710
 KY1710  STATE/COUNTY-  OH/WAYNE
 KY1710  USGS QUAD   -  DOYLESTOWN (1994)
 KY1710
 KY1710                        *CURRENT SURVEY CONTROL
 KY1710  ___________________________________________________________________
 KY1710* NAD 83(1995)-  40 56 43.02942(N)    081 43 01.98467(W)     ADJUSTED
 KY1710* NAVD 88     -       292.011  (meters)     958.04   (feet)  ADJUSTED
 KY1710  ___________________________________________________________________
 KY1710  X           -     695,050.831 (meters)                     COMP
 KY1710  Y           -  -4,774,444.119 (meters)                     COMP
 KY1710  Z           -   4,158,005.200 (meters)                     COMP
 KY1710  LAPLACE CORR-           0.22  (seconds)                    DEFLEC99
 KY1710  ELLIP HEIGHT-         258.88  (meters)          (10/07/05) GPS OBS
 KY1710  GEOID HEIGHT-         -33.13  (meters)                     GEOID03
 KY1710  DYNAMIC HT  -         291.882 (meters)     957.62  (feet)  COMP
 KY1710  MODELED GRAV-     980,175.8   (mgal)                       NAVD 88
 KY1710
 KY1710  HORZ ORDER  -  FIRST
 KY1710  VERT ORDER  -  FIRST     CLASS I
 KY1710  ELLP ORDER  -  FOURTH    CLASS I
 KY1710
 KY1710.The horizontal coordinates were established by GPS observations
 KY1710.and adjusted by the National Geodetic Survey in April 1998.
 KY1710
 KY1710.The orthometric height was determined by differential leveling
 KY1710.and adjusted by the National Geodetic Survey in June 1991.
 KY1710
 KY1710.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 KY1710
 KY1710.The Laplace correction was computed from DEFLEC99 derived deflections.
 KY1710
 KY1710.The ellipsoidal height was determined by GPS observations
 KY1710.and is referenced to NAD 83.
 KY1710
 KY1710.The geoid height was determined by GEOID03.
 KY1710
 KY1710.The dynamic height is computed by dividing the NAVD 88
 KY1710.geopotential number by the normal gravity value computed on the
 KY1710.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 KY1710.degrees latitude (g = 980.6199 gals.).
 KY1710
 KY1710.The modeled gravity was interpolated from observed gravity values.
 KY1710
 KY1710;                    North         East     Units Scale Factor Converg.
 KY1710;SPC OH N     -   142,281.050   665,909.197   MT  0.99994141   +0 30 51.3
 KY1710;UTM  17      - 4,532,930.936   439,630.793   MT  0.99964485   -0 28 12.1
 KY1710
 KY1710!             -  Elev Factor  x  Scale Factor =   Combined Factor
 KY1710!SPC OH N     -   0.99995939  x   0.99994141  =   0.99990081
 KY1710!UTM  17      -   0.99995939  x   0.99964485  =   0.99960426
 KY1710
 KY1710                         SUPERSEDED SURVEY CONTROL
 KY1710
 KY1710  ELLIP H (04/01/98)  258.93   (m)                       GP(       ) 4 1
 KY1710  NAD 83(1986)-  40 56 43.03737(N)    081 43 01.98939(W) AD(       ) 1
 KY1710  NGVD 29 (??/??/92)  292.214  (m)          958.71   (f) ADJ UNCH    1 1
 KY1710
 KY1710.Superseded values are not recommended for survey control.
 KY1710.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 KY1710.See file dsdata.txt to determine how the superseded data were derived.
 KY1710
 KY1710_U.S. NATIONAL GRID SPATIAL ADDRESS: 17TMF3963132931(NAD 83)
 KY1710_MARKER: DB = BENCH MARK DISK
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KY1710_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
KY1710_SP_SET: SET IN TOP OF CONCRETE MONUMENT
KY1710_STAMPING: N 177 1954
KY1710_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
KY1710+STABILITY: SURFACE MOTION
KY1710_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
KY1710+SATELLITE: SATELLITE OBSERVATIONS - October 19, 1983
KY1710
KY1710  HISTORY     - Date     Condition        Report By
KY1710  HISTORY     - 1954     MONUMENTED       CGS
KY1710  HISTORY     - 1967     GOOD             NGS
KY1710  HISTORY     - 1971     GOOD             OHDT
KY1710  HISTORY     - 19831019 GOOD
KY1710  HISTORY     - 1987     GOOD             OHDT
KY1710  HISTORY     - 20031024 GOOD             USPSQD
KY1710
KY1710                          STATION DESCRIPTION
KY1710
KY1710'DESCRIBED BY NATIONAL GEODETIC SURVEY 1967
KY1710'3.8 MI SE FROM RITTMAN.
KY1710'ABOUT 3.85 MILES SOUTHEAST ALONG THE BALTIMORE AND OHIO RAILROAD
KY1710'FROM THE STATION AT RITTMAN, IN SECTION 21, R 11 W, T 18 N, 81
KY1710'FEET SOUTHWEST OF AND ACROSS THE TRACK FROM MILEPOLE 148-5,
KY1710'69 FEET SOUTH OF THE CENTER OF THE CROSSING OF TOWNSHIP ROAD
KY1710'NO. 15 AND THE SOUTHWEST ONE OF TWO TRACKS, 42.2 FEET SOUTHWEST
KY1710'OF THE SOUTHWEST RAIL OF THE SOUTHWEST TRACK, 23 FEET SOUTHEAST
KY1710'OF THE CENTER LINE OF THE ROAD, 2 1/2 FEET NORTHEAST OF A FENCE
KY1710'CORNER, 1 FOOT SOUTHEAST OF A METAL WITNESS POST, 2 1/2 FEET
KY1710'BELOW THE LEVEL OF THE TRACK AND SET IN THE TOP OF A CONCRETE
KY1710'POST PROJECTING 0.2 FOOT ABOVE THE LEVEL OF THE GROUND.
KY1710'NOTE-- MARK MAY BE REACHED BY GOING 4.15 MILES NORTHWEST ALONG
KY1710'THE BALTIMORE AND OHIO RAILROAD FROM THE SWITCH TOWER AT WARWICK.
KY1710
KY1710                          STATION RECOVERY (1971)
KY1710
KY1710'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1971
KY1710'RECOVERED IN GOOD CONDITION.
KY1710
KY1710                          STATION RECOVERY (1983)
KY1710
KY1710'RECOVERED 1983
KY1710'RECOVERED IN GOOD CONDITION.
KY1710
KY1710                          STATION RECOVERY (1987)
KY1710
KY1710'RECOVERY NOTE BY OHIO DEPARTMENT OF TRANSPORTATION 1987 (ROS)
KY1710'RECOVERED IN GOOD CONDITION.
KY1710
KY1710                          STATION RECOVERY (2003)
KY1710
KY1710'RECOVERY NOTE BY US POWER SQUADRON 2003
KY1710'RECOVERED IN GOOD CONDITION.
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Appendix 2. Selected Hydrologic Engineers Center's River Analysis System Output for Chippewa Creek, Westfield Ditch, River Styx, and Little Chippewa Creek

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
369	2710	929.5	942.18	942.28	0.000167	2.56	1080.69	1236	0.14
647	2710	929.5	942.22	942.34	0.000194	2.68	1010.86	880	0.15
751	2710	931.3	942.23	942.38	0.00032	3.06	891.31	252	0.19
766	Railroad (bridge)								
777	2710	931.3	942.32	942.46	0.000321	3.03	900.53	253	0.19
914	2710	931.1	942.35	942.53	0.000416	3.4	798.05	222	0.21
1000	2710	930.8	942.44	942.56	0.000224	2.78	1062.5	356	0.16
1288	2710	929.9	942.53	942.61	0.000142	2.29	1209.58	918	0.13
1500	2710	929.2	942.56	942.65	0.000157	2.39	1145.5	675	0.14
1768	2710	928.3	942.55	942.74	0.000353	3.42	804.68	765	0.19
1797	2710	928.5	942.62	942.76	0.000291	3	904.49	411	0.17
1822	North Lawrence Road / Deerfield Road / South 2nd Avenue (bridge)								
1845	2710	928.5	942.66	942.8	0.000289	2.98	908.45	96.5	0.17
1893	2710	928.3	942.71	942.82	0.000183	2.61	1043.61	113	0.14
2372	2710	928.6	942.81	942.9	0.000136	2.36	1498.01	526	0.12
2796	2710	928.9	942.87	942.95	0.00013	2.28	1850.79	845	0.12
3092	2710	929.1	942.92	942.99	0.000124	2.16	1868.78	865	0.12
3512	2710	929.3	942.98	943.04	0.000141	2.14	2095.95	1107	0.12
3970	2710	929.6	943.03	943.12	0.000191	2.53	1340.56	929	0.14
4442	2710	929.9	943.12	943.21	0.000168	2.46	1248.37	975	0.13
4834	2710	930.2	943.17	943.31	0.000281	3.03	894.31	984	0.17
4896	2710	928.9	943.18	943.33	0.000279	3.04	891.79	98.1	0.17
4962	State Route 21 / Great Lakes Boulevard (bridge)								
5019	2710	928.9	943.19	943.41	0.000474	3.76	727.6	98.2	0.22
5251	2710	931.5	943.38	943.52	0.000296	3	922.9	569	0.17
5582	2710	930.9	943.5	943.6	0.000196	2.6	1091.74	1088	0.14
5891	2710	930.3	943.56	943.66	0.000171	2.53	1094.44	1237	0.13
6167	2710	929.8	943.62	943.7	0.00014	2.38	1178.77	1297	0.12
6488	2710	929.1	943.67	943.74	0.000112	2.17	1269.05	1100	0.11
6760	2710	928.6	943.7	943.78	0.000114	2.22	1235.52	818	0.11
6997	2710	928.2	943.74	943.8	0.000102	2.08	1303.3	596	0.1
7195	2710	927.8	943.76	943.82	0.000087	2.04	1354.23	426	0.1
7480	2710	927.3	943.78	943.85	0.000099	2.07	1334.94	481	0.1
7669	2710	926.9	943.78	943.89	0.0002	2.64	1051.74	394	0.14
7808	2710	930.2	943.8	943.93	0.000284	2.89	940.63	211	0.16
7831	Railroad (bridge)								
7851	2710	930.2	943.81	943.94	0.000302	2.91	932.2	100	0.16
7978	2710	930.8	943.84	943.99	0.000321	3.12	903.68	1307	0.17
8289	2710	930.9	943.98	944.07	0.000168	2.45	1249.3	1411	0.13
8451	2710	930.9	944.02	944.1	0.000142	2.26	1766.35	1418	0.12
8779	2710	931	944.08	944.14	0.000129	2.13	1962.87	1575	0.11

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
9076	2710	931.1	944.13	944.18	0.000096	1.85	2711.06	1708	0.1
9390	2710	931.2	944.15	944.22	0.000128	2.13	2225.67	1933	0.11
9763	2710	931.3	944.2	944.26	0.00013	2.13	2472.31	2066	0.11
10093	2710	931.4	944.25	944.3	0.000125	2.09	2741.79	1893	0.11
10396	2710	931.5	944.29	944.34	0.000133	2	2836.09	2151	0.11
10696	2710	931.5	944.32	944.38	0.000136	2.14	2691.84	2116	0.11
11076	2710	931.6	944.38	944.43	0.000118	1.98	3314.47	2089	0.11
11402	2710	931.7	944.43	944.47	0.000118	1.84	3285.84	2153	0.11
11752	2710	931.8	944.46	944.51	0.000115	1.9	3087.02	2332	0.1
12175	2710	931.9	944.51	944.56	0.000136	2.09	2563.13	2282	0.11
12590	2710	932.1	944.55	944.64	0.000191	2.45	1611.36	2351	0.13
13040	2710	932.2	944.64	944.74	0.000239	2.58	1476.24	2622	0.15
13447	2710	932.3	944.75	944.82	0.000172	2.33	1831.63	2292	0.13
13837	2710	932.4	944.8	944.93	0.000331	3.03	1168.91	2616	0.17
14304	2680	932.3	944.96	945.06	0.000217	2.53	1071.82	2340	0.14
14726	2680	932.2	945.05	945.14	0.000188	2.44	1118.86	759	0.13
15157	2680	932	945.13	945.22	0.000172	2.37	1307.17	820	0.13
15635	2680	932	945.22	945.31	0.000204	2.44	1098.37	874	0.14
16068	2680	931.9	945.31	945.39	0.000161	2.29	1185.24	536	0.12
16504	2680	931.8	945.38	945.45	0.000139	2.27	1212.3	461	0.12
16775	2680	931.7	945.41	945.49	0.000131	2.29	1229.22	487	0.12
16962	2680	931.7	945.41	945.54	0.000269	2.97	935.35	284	0.17
17055	2680	933.7	945.44	945.57	0.000234	2.9	943.57	104	0.16
17074	Black Diamond Road / Bieri Road (bridge)								
17096	2680	933.7	945.45	945.58	0.000208	2.9	944.53	104	0.16
17204	2680	933	945.48	945.6	0.000207	2.79	968.27	585	0.15
17595	2680	932.9	945.57	945.67	0.000165	2.57	1064.84	923	0.14
18013	2680	932.8	945.64	945.74	0.00015	2.51	1092.39	1333	0.13
18425	2680	932.6	945.71	945.8	0.000135	2.42	1133.98	1361	0.13
18814	2680	932.5	945.76	945.86	0.000147	2.57	1120.8	1335	0.13
19226	2680	932.4	945.83	945.92	0.000138	2.4	1171.53	1177	0.13
19643	2680	932.3	945.89	945.97	0.000119	2.35	1187.64	454	0.12
20055	2680	932.2	945.94	946.02	0.000112	2.28	1203.35	172	0.12
20477	2680	932	945.99	946.07	0.000125	2.28	1174.5	826	0.12
20866	2680	931.9	946.04	946.12	0.000112	2.26	1210.09	1264	0.12
21265	2680	931.8	946.08	946.16	0.000112	2.24	1214	1394	0.12
21658	2680	931.7	946.13	946.21	0.000135	2.33	1151.22	781	0.12
22031	2680	931.6	946.18	946.26	0.000134	2.23	1210.83	941	0.12
22455	2680	931.4	946.24	946.31	0.000115	2.21	1260.05	1060	0.12
22909	2680	931.3	946.29	946.37	0.000136	2.29	1169.83	913	0.13
22936	2680	933.2	946.29	946.38	0.000146	2.34	1214.95	792	0.13

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
22955	Coal Bank Road (bridge								
22976	2680	933.2	946.3	946.39	0.000168	2.43	1276.37	849	0.14
23070	2680	934	946.37	946.42	0.000116	2	2035.39	928	0.11
23302	2680	933.9	946.38	946.45	0.000134	2.28	1650.45	938	0.13
23725	2680	933.8	946.43	946.52	0.000142	2.41	1399.42	776	0.13
24137	2680	933.7	946.5	946.58	0.000138	2.33	1784.71	1093	0.13
24488	2680	933.6	946.57	946.62	0.000118	2.05	2293.49	993	0.11
24885	2680	933.5	946.63	946.66	0.000075	1.64	3333.21	1348	0.09
25238	2680	933.5	946.65	946.7	0.000116	1.99	1936.18	1275	0.11
25572	2680	933.4	946.69	946.74	0.000114	2.04	1906.83	1860	0.11
25962	2680	933.3	946.72	946.8	0.000146	2.28	1365.03	2505	0.12
26370	2490	933.2	946.81	946.85	0.000097	1.81	1653.88	1970	0.1
26704	2490	933.1	946.83	946.9	0.000127	2.16	1178.08	2495	0.12
27089	2490	933	946.88	946.94	0.000113	2.09	1209.43	2612	0.11
27400	2490	932.9	946.91	946.98	0.000114	2.1	1183.78	2009	0.11
27785	2490	932.8	946.95	947.03	0.000131	2.19	1137.42	2070	0.12
28246	2490	932.7	947.01	947.11	0.000185	2.52	996.85	2024	0.14
28346	2490	932.6	947.02	947.14	0.000245	2.68	928.42	2597	0.16
28373	Porr Road / Township Road 261 (bridge)								
28391	2490	932.6	947.04	947.15	0.000244	2.68	929.63	2206	0.16
28517	2490	933.1	947.06	947.18	0.000203	2.69	954.5	1663	0.14
28861	2490	933.2	947.16	947.23	0.000124	2.16	1202.39	2303	0.11
29199	2490	933.4	947.2	947.28	0.000139	2.28	1106.45	1506	0.12
29592	2490	933.5	947.26	947.34	0.000163	2.29	1089.15	1460	0.13
29865	2400	933.6	947.3	947.38	0.000168	2.31	1040.53	2108	0.13
30191	2400	933.8	947.36	947.44	0.00017	2.31	1036.86	1265	0.13
30484	2400	933.9	947.41	947.49	0.000181	2.35	1020.78	233	0.13
30794	2400	934	947.46	947.54	0.000141	2.24	1072.42	222	0.12
31146	2400	934.2	947.51	947.59	0.000148	2.26	1060.75	164	0.12
31578	2400	934.3	947.58	947.66	0.00015	2.26	1062.01	103	0.12
32011	2400	934.5	947.65	947.72	0.000145	2.21	1085.38	108	0.12
32479	2400	934.7	947.72	947.8	0.000172	2.3	1043.47	110	0.13
32951	2400	934.9	947.8	947.87	0.000138	2.17	1107.91	110	0.12
33360	2400	935.1	947.85	947.93	0.000156	2.27	1059.28	108	0.13
33751	2400	935.2	947.91	948	0.000162	2.33	1028.79	102	0.13
34155	2440	935.4	947.97	948.07	0.000184	2.57	968.36	307	0.14
34277	2440	934.7	948	948.09	0.00016	2.54	1028.13	121	0.13
34314	State Route 95 / State Route 585 / Akron Road / Mt Eaton Road (bridge)								
34348	2440	934.7	948.02	948.12	0.000159	2.5	1033.22	193	0.13
34451	2440	935.2	948.04	948.14	0.000192	2.45	999.49	925	0.14
34776	2440	935.3	948.11	948.2	0.000176	2.4	1015.24	784	0.13

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
35181	2440	935.4	948.18	948.27	0.000158	2.33	1046.97	1600	0.13
35580	2440	935.5	948.24	948.33	0.000172	2.38	1043.53	1716	0.13
36039	2440	935.7	948.32	948.41	0.000175	2.4	1016.49	959	0.13
36176	2440	935.7	948.34	948.44	0.000203	2.51	973.75	719	0.14
36467	2440	935.8	948.41	948.49	0.000164	2.39	1022.63	843	0.13
36932	2440	935.9	948.49	948.57	0.000145	2.27	1077.75	1267	0.12
37314	2440	936	948.54	948.63	0.00017	2.35	1039.19	1219	0.13
37739	2440	936.1	948.62	948.71	0.000189	2.43	1006.1	1337	0.14
38109	2440	936.2	948.69	948.77	0.000169	2.37	1027.72	1425	0.13
38526	2440	936.4	948.76	948.84	0.000168	2.35	1038.82	890	0.13
38966	2440	936.5	948.83	948.92	0.00016	2.33	1047.47	694	0.13
39294	2440	936.6	948.88	948.97	0.000168	2.36	1033.85	489	0.13
39586	2440	936.7	948.94	949.02	0.000164	2.32	1051.42	387	0.13
39846	2440	936.7	948.98	949.06	0.000165	2.33	1047.55	660	0.13
40103	2440	936.8	949.02	949.1	0.000165	2.32	1052.67	758	0.13
40426	2440	936.9	949.07	949.16	0.000191	2.41	1013.56	613	0.14
40822	2440	937	949.16	949.24	0.000183	2.24	1089.88	893	0.14
41177	2440	937.1	949.23	949.31	0.0002	2.22	1098.79	2138	0.14
41321	2440	937.1	949.26	949.33	0.000162	2.15	1136.39	133	0.13
41350	State Route 57 / Wadsworth Road (bridge)								
41377	2440	937.1	949.28	949.35	0.000161	2.14	1139.09	133	0.13
41438	2440	937.3	949.29	949.37	0.000225	2.29	1067.03	480	0.15
41788	2440	937.1	949.37	949.45	0.000211	2.28	1077.64	151	0.14
42226	2050	936.9	949.46	949.53	0.000165	2.18	939.55	230	0.13
42620	2050	936.7	949.52	949.6	0.000181	2.28	897.72	226	0.13
43012	2050	936.5	949.59	949.67	0.000175	2.26	908.38	267	0.13
43447	2050	936.2	949.67	949.75	0.000184	2.28	898.85	241	0.13
43912	2050	936	949.76	949.82	0.000143	2.11	971.18	242	0.12
44302	2050	935.8	949.81	949.88	0.000155	2.12	969.17	699	0.12
44669	2050	935.6	949.87	949.94	0.00015	2.1	973.92	396	0.12
45144	2050	935.3	949.94	950	0.000122	2.04	1002.97	194	0.11
45196	2050	938.8	949.94	950.01	0.000157	2.18	941.21	208	0.13
45205	Low head dam (inline structure)								
45206	2050	940.8	949.99	950.11	0.00032	2.77	741.32	203	0.18
45241	2050	940.8	950	950.12	0.000319	2.76	742.41	200	0.18
45664	2050	940.6	950.13	950.25	0.000298	2.76	742.77	171	0.17
46034	1520	940.4	950.25	950.36	0.000318	2.74	555.57	234	0.17
46409	1520	940.2	950.38	950.46	0.000193	2.25	814.96	435	0.14
46617	1520	940.1	950.41	950.52	0.000298	2.7	562.75	468	0.17
46739	1520	939.3	950.41	950.62	0.000713	3.69	412	233	0.25

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
46766				South Main Street (bridge)					
46788	1520	939.3	950.45	950.66	0.000701	3.67	414.72	117	0.25
46970	1520	940.5	950.64	950.78	0.00038	2.97	512.47	115	0.19
47369	1520	940.5	950.79	950.93	0.000403	3.02	503.71	143	0.19
47725	1520	940.5	950.94	951.08	0.000408	2.95	515.7	826	0.19
48072	1520	940.5	951.08	951.21	0.000348	2.91	521.64	447	0.18
48466	1520	940.5	951.21	951.36	0.000393	3.07	495.34	320	0.19
48833	1520	940.5	951.36	951.5	0.000368	2.96	513.16	1186	0.19
49198	1520	940.6	951.5	951.63	0.000331	2.85	533.31	806	0.18
49517	1520	940.6	951.61	951.73	0.000321	2.82	539.18	723	0.17
49843	1520	940.6	951.72	951.83	0.000299	2.73	557.54	455	0.17
50233	1520	940.6	951.83	951.94	0.000256	2.65	587.05	384	0.16
50677	1520	940.6	951.96	952.04	0.000199	2.3	697.45	733	0.14
50898	1520	940.6	952	952.1	0.000252	2.53	599.71	662	0.15
51026	1520	940.7	952.03	952.14	0.000287	2.67	569.61	1335	0.17
51305	1520	940.8	952.11	952.21	0.000228	2.51	630.19	2357	0.15
51623	1520	941	952.18	952.31	0.000379	2.88	546.64	2735	0.19
51886	1520	941.1	952.28	952.4	0.00032	2.78	547.86	2864	0.17
52294	1520	941.4	952.41	952.54	0.000343	2.89	526.91	2634	0.18
52646	1520	941.5	952.53	952.67	0.000363	2.92	521.39	2227	0.18
52969	1520	941.7	952.65	952.79	0.000409	3.01	504.26	3437	0.2
53294	1520	941.9	952.77	952.97	0.000608	3.63	418.49	1963	0.23
53311	1520	942.8	952.77	952.99	0.000624	3.75	405.22	1908	0.23
53318				Private drive (bridge)					
53329	1520	942.8	952.74	953.07	0.001254	4.61	329.76	1921	0.33
53354	1520	942.2	952.9	953.12	0.000763	3.79	401.18	1974	0.26
53652	1520	941.9	953.15	953.28	0.000357	2.9	523.32	731	0.18
54107	1410	941.3	953.32	953.43	0.000302	2.7	523	491	0.17
54508	1410	940.9	953.44	953.55	0.000266	2.58	546.81	203	0.16
54827	1410	940.5	953.52	953.64	0.000295	2.72	518.62	407	0.16
55163	1410	940.1	953.63	953.74	0.000305	2.73	516.57	230	0.16
55585	1410	939.6	953.76	953.85	0.000234	2.51	561.45	158	0.14
55943	1410	939.2	953.84	953.96	0.000339	2.88	490.27	101	0.17
55991	1410	942.2	953.84	953.99	0.000368	3.06	460.81	85.0	0.18
56006				Blough Road (bridge)					
56023	1410	942.2	953.76	954.12	0.00133	4.76	296.21	45.8	0.33
56061	1410	941.4	953.98	954.19	0.000722	3.7	381.18	54.3	0.25
56369	1410	941.3	954.23	954.34	0.000304	2.73	517.29	902	0.17
56714	1410	941.1	954.33	954.45	0.00032	2.78	508	194	0.17
57096	1410	941	954.45	954.57	0.000298	2.72	518.3	92.8	0.16
57512	1410	940.8	954.58	954.71	0.00035	2.92	483.63	94.4	0.17

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
57895	1410	940.6	954.72	954.83	0.000285	2.69	525.01	97.2	0.16
58298	1410	940.5	954.83	954.94	0.000262	2.66	529.78	130	0.15
58664	1330	940	954.93	955.05	0.000346	2.8	474.92	121	0.16
58758	1330	945	954.93	955.14	0.000697	3.66	363.31	768	0.22
58775	Shorle Road (multiple opening)								
58789	1330	945	954.86	955.27	0.001131	5.09	261.43	77.2	0.37
58830	1330	944.3	955.16	955.36	0.000449	3.52	378.32	90.2	0.23
59197	1330	944.2	955.35	955.5	0.000343	3.15	422.61	97.6	0.21
59547	1330	944.1	955.48	955.62	0.000298	3.02	440.57	103	0.2
59864	1330	944	955.56	955.72	0.000319	3.14	423.83	308	0.2
60198	1330	943.9	955.67	955.83	0.000353	3.26	408.48	101	0.21
60551	1330	943.8	955.8	955.95	0.000333	3.17	419.67	128	0.2
60911	1330	943.7	955.92	956.09	0.000375	3.31	401.93	124	0.21
61169	1330	943.6	956.02	956.18	0.000343	3.19	416.69	175	0.2
61545	1330	943.5	956.14	956.31	0.000347	3.34	398.8	65.4	0.21
61584	1330	947.7	956.14	956.35	0.000482	3.63	366.47	67.7	0.24
61603	Frick Road / Township Road 215 (bridge)								
61621	1330	947.7	956.05	956.49	0.001528	5.32	250.03	539	0.43
61736	1330	946	956.35	956.66	0.000809	4.44	299.52	47.1	0.31
62179	1330	946.6	956.73	957.01	0.000756	4.24	313.63	49.7	0.3
62569	1330	947.2	957.02	957.32	0.000813	4.36	305.33	49.6	0.31
62957	1330	947.8	957.34	957.63	0.000819	4.32	308.16	52.1	0.31
63398	1330	948.4	957.71	958.03	0.000918	4.55	292.56	49.4	0.33
63869	1330	949.1	958.14	958.52	0.00113	4.97	267.71	44.9	0.36
64302	1330	949.7	958.63	959.01	0.001136	4.97	267.42	46.8	0.37
64643	1330	950.2	959.03	959.44	0.001346	5.14	258.61	50.4	0.4
64690	1330	949.5	959.2	959.52	0.000839	4.54	293.26	46.7	0.32
64706	Seville Road / County Highway 60 (bridge)								
64721	1330	949.5	959.25	959.56	0.000832	4.5	295.45	47.3	0.32
64754	1330	950.6	959.25	959.62	0.001147	4.9	271.52	50.0	0.37
65216	1330	950.4	959.78	959.99	0.000551	3.7	359.29	57.9	0.26
65654	1330	950.1	960.02	960.24	0.000556	3.72	357.96	57.8	0.26
65987	1330	950	960.23	960.41	0.00045	3.37	394.45	63.7	0.24
66321	1330	949.8	960.35	960.64	0.000836	4.34	306.43	52.5	0.32
66365	1330	951.8	960.43	960.69	0.000713	4.09	324.94	216	0.3
66382	Sterling Road / County Highway 504 (bridge)								
66404	1330	951.8	960.45	960.73	0.000908	4.27	311.67	60.26	0.32
66474	1330	951.4	960.51	960.81	0.00106	4.39	303.13	103.35	0.33
66782	1330	951.9	960.83	961.1	0.000835	4.12	322.61	55.53	0.3
67142	1330	952.5	961.14	961.42	0.000927	4.21	315.79	57.39	0.32
67537	1070	953.1	961.55	961.74	0.000661	3.53	302.73	55.43	0.27

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
67908	1070	953.6	961.8	962.04	0.000909	3.95	270.95	52.75	0.31
68280	1070	954.3	962.14	962.4	0.001018	4.11	260.36	52.13	0.32
68630	1070	954.8	962.5	962.76	0.001001	4.05	264.18	247.15	0.32
68988	1070	955.4	962.88	963.18	0.001337	4.44	241.07	75.21	0.37
69018	1070	955.4	962.93	963.22	0.001088	4.37	244.87	46.31	0.33
69031	Miller Road / Chestnut Road (bridge)								
69044	1070	955.4	962.97	963.26	0.001219	4.31	248.32	48.05	0.33
69071	1070	954	963.12	963.31	0.000677	3.51	305.27	51.29	0.25
69402	1070	954.6	963.37	963.59	0.000999	3.77	284.14	52.75	0.29
69879	1070	955.6	963.84	964.06	0.000977	3.82	280.37	50.79	0.29
70316	1070	956.4	964.26	964.44	0.000731	3.34	321.68	363.35	0.25
70700	1070	957.2	964.56	964.76	0.000941	3.62	298.42	71.03	0.28
71168	1070	958.1	965.03	965.19	0.000874	3.22	331.96	69.38	0.26
71195	1070	956.3	965.12	965.23	0.000585	2.62	407.68	82.72	0.21
71226	Railroad (bridge)								
71253	1070	956.3	965.26	965.35	0.000437	2.5	433.96	89.69	0.19
71296	1070	955.4	965.27	965.38	0.000469	2.65	414.56	84.9	0.2
71724	1070	957.9	965.48	965.54	0.000299	2.11	612.51	270.49	0.16
72093	1070	958.1	965.57	965.71	0.000566	2.99	358.19	64.29	0.22
72487	1070	958.3	965.8	966.03	0.001011	3.82	280.4	155.05	0.29
72880	1070	958.5	966.21	966.44	0.001076	3.89	275.25	827.16	0.3
73271	1070	958.7	966.64	966.83	0.000877	3.5	336.51	786.3	0.27
73547	1070	958.9	966.92	966.97	0.000284	1.79	671.45	150.18	0.12
73953	1070	958.9	967.01	967.21	0.000951	3.64	300.47	325.28	0.28
74390	1070	958.9	967.4	967.64	0.000979	3.94	281.15	61.91	0.29
74746	1070	959	967.75	967.86	0.000363	2.65	448.46	129.06	0.18
75148	1070	959	967.9	968.06	0.000636	3.19	338.79	81.75	0.26
75413	1070	959	968.06	968.25	0.000737	3.53	302.94	71.91	0.28
75467	1070	959	968.09	968.3	0.000801	3.69	290.17	80.97	0.29
75500	1070	960.9	968.11	968.33	0.000891	3.78	283.4	105.96	0.31
75521	Doylestown Road (bridge)								
75547	1070	960.9	968.17	968.38	0.001168	3.69	289.95	1690.38	0.31
75599	1070	960.1	968.2	968.49	0.001603	4.29	251.27	202.18	0.36
75996	1070	960.5	968.72	968.9	0.000702	3.42	319.54	74.59	0.25
76467	1070	961	969.07	969.24	0.000739	3.35	339.2	150.25	0.25
76893	1020	961.5	969.43	969.56	0.000745	3	349.29	101.86	0.25
77311	1020	962	969.75	969.92	0.000912	3.29	316	82.54	0.27
77778	1020	962.5	970.16	970.29	0.000688	2.91	373.58	385.91	0.24
78188	1020	962.9	970.43	970.7	0.00124	4.13	247.1	47.64	0.32
78529	1020	963.3	970.87	971.09	0.001022	3.72	274.13	54.57	0.29
78890	1020	963.7	971.25	971.45	0.000976	3.61	282.86	57.27	0.29

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
79196	1020	964	971.54	971.84	0.001447	4.36	233.92	46.13	0.34
79526	1020	964.4	972.02	972.25	0.001075	3.89	262.03	62.42	0.31
79908	1020	964.8	972.44	972.67	0.001109	3.83	270.81	81.11	0.32
80277	1020	965.2	972.82	972.97	0.000598	3.13	347	93.38	0.24
80625	1020	965.8	973.04	973.29	0.001241	4.03	252.89	56.53	0.34
80996	1020	966.3	973.5	973.73	0.001117	3.85	265.02	59.21	0.32
81293	1020	966.8	973.85	974.11	0.001377	4.07	250.55	60.04	0.35
81679	1020	967.4	974.4	974.62	0.001269	3.79	272.63	86.55	0.34
82067	1020	968.1	974.93	975.19	0.001667	4.05	251.94	74.76	0.38
82428	1020	968.6	975.56	975.82	0.00182	4.12	248.36	88.42	0.39
82776	1020	969.2	976.16	976.45	0.001742	4.34	235.02	171.78	0.39
83098	1020	969.7	976.67	976.9	0.001133	3.85	272.71	162.44	0.32
83366	1020	970.1	976.98	977.3	0.001703	4.54	229.24	68.94	0.37
83536	1020	970.4	977.27	977.59	0.001733	4.54	224.61	57.48	0.37
83564	1020	970.5	977.37	977.65	0.001285	4.19	243.65	117.86	0.32
83578	Mill Road (bridge)								
83593	1020	970.5	977.47	977.69	0.001127	3.82	266.84	76.96	0.3
83618	1020	970	977.48	977.74	0.001344	4.05	251.63	54.41	0.33
83936	1020	970.3	977.93	978.14	0.001154	3.66	278.68	58.24	0.29
84272	1020	970.6	978.31	978.47	0.000816	3.23	316.49	118.44	0.25
84627	1020	971	978.61	978.8	0.001059	3.5	293.95	146.18	0.28
84963	1020	971.3	978.96	979.12	0.000829	3.24	332.51	172.25	0.25
85236	1020	971.5	979.18	979.36	0.00091	3.42	298.62	57.45	0.26
85438	1020	971.7	979.35	979.59	0.001156	3.86	264.26	49.54	0.29
85614	1020	971.9	979.56	979.79	0.001151	3.81	267.56	51.04	0.29
85621	Low head dam (inline structure)								
85628	1020	971.9	979.74	979.95	0.001031	3.71	275.17	50.13	0.28
85913	1020	971.7	980.02	980.25	0.001022	3.85	265.22	43.58	0.27
85993	1020	973.7	980.04	980.49	0.002778	5.4	188.87	40.96	0.44
86021	State Route 3 / West Main Street (bridge)860								
86050	1020	973.7	980.12	980.91	0.006029	7.11	143.39	37.34	0.64
86116	1020	974.3	980.94	981.25	0.001802	4.45	229.26	45.44	0.35
86475	848	974.2	981.48	981.59	0.000487	2.78	383.47	131.88	0.2
86852	848	974.1	981.68	981.74	0.000305	2.19	530.75	247.12	0.16
87176	848	974	981.77	981.81	0.000143	1.68	697.89	230.73	0.11
87497	848	973.9	981.82	981.85	0.000109	1.45	882.34	285	0.1
87827	848	973.7	981.86	981.89	0.000113	1.5	940.08	315	0.1
88094	848	973.7	981.89	981.91	0.000087	1.34	1066.17	352	0.09
88348	848	973.6	981.92	981.93	0.000082	1.32	1210.79	402	0.09
88603	848	973.5	981.94	981.96	0.000092	1.29	1145.95	431	0.09
88898	848	973.4	981.96	982.02	0.000228	2.04	474.09	185	0.14

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
88905				Pipeline (bridge)					
88914	848	973.4	981.96	982.02	0.000228	2.04	474.86	186	0.14
89231	848	973.3	982.06	982.08	0.000082	1.29	888.52	232	0.09
89549	848	973.3	982.08	982.1	0.000082	1.31	1014.71	317	0.08
90013	848	973.2	982.12	982.14	0.000074	1.31	1086.18	491	0.09
90396	848	973.1	982.15	982.17	0.000087	1.35	925.25	487	0.09
90717	848	973	982.18	982.2	0.000069	1.24	1003.41	850	0.08
90957	848	973	982.18	982.23	0.00016	1.84	489.79	657	0.12
91024	848	973.8	982.18	982.26	0.000295	2.27	373.94	218	0.17
91042				Greenwich Road (bridge)					
91063	848	973.8	982.19	982.27	0.000228	2.26	374.65	67.9	0.17
91159	848	973.8	982.26	982.3	0.000108	1.62	668.19	500	0.12
91460	848	973.9	982.3	982.31	0.000028	0.93	1295.8	767	0.06
91741	848	974	982.31	982.32	0.000018	0.71	1786.39	639	0.05
92060	848	974.1	982.32	982.33	0.000017	0.68	1931.23	1173	0.05
92386	848	974.2	982.33	982.33	0.000042	0.99	1473.92	592	0.07
92668	848	974.3	982.34	982.34	0.000026	0.82	1818.78	640	0.06
92946	848	974.4	982.35	982.35	0.000021	0.72	2058.93	1014	0.05
93282	848	974.5	982.35	982.36	0.000016	0.63	2313.79	1358	0.04
93622	848	974.7	982.36	982.36	0.000024	0.71	2064.6	1407	0.05
93998	848	974.8	982.37	982.37	0.00003	0.83	1871.61	1139	0.06
94381	848	974.9	982.38	982.39	0.000032	0.87	1775.58	865	0.06
94738	848	975	982.39	982.4	0.000032	0.88	1585.43	1025	0.06
95133	848	975.2	982.4	982.42	0.000083	1.26	1024.67	1189	0.1
95480	848	975.3	982.43	982.46	0.000115	1.61	810	1276	0.12
95792	848	975.4	982.43	982.54	0.000381	2.65	320.2	1421	0.2
95932	848	975.8	982.45	982.7	0.001141	4.03	210.24	48.3	0.34
96013				Interstate Route 76 / State Route 224 (bridge)					
96088	848	975.8	982.79	983.11	0.002253	4.53	187.12	46.8	0.4
96297	848	974.5	983.32	983.47	0.001058	3.21	322.41	1614	0.27
96450	848	976.1	983.48	983.73	0.002095	4.02	211.27	61.9	0.38
96532				Interstate Route 71 (bridge)					
96611	848	976.1	983.84	984.04	0.001605	3.64	233.92	66.1	0.33
96732	848	974.6	984.15	984.22	0.000863	2.47	447.57	1457	0.24
97086	848	975	984.34	984.37	0.000245	1.67	719.33	1701	0.14
97525	848	975.6	984.47	984.5	0.000385	1.82	767.68	2009	0.16
97924	848	976.1	984.63	984.69	0.000549	2.21	656.69	1489	0.2
98239	848	976.5	984.77	984.8	0.000226	1.53	898.25	1741	0.13
98605	800	977	984.86	984.91	0.000385	2.05	594.88	2392	0.18
98991	800	977.5	985.05	985.13	0.001142	2.73	419.44	2288	0.28

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
99342	800	978	985.39	985.53	0.001176	3.04	299.21	1692	0.3
99695	800	978.4	985.79	985.93	0.001104	3.03	279.63	1184	0.29
100060	800	978.8	986.3	986.51	0.002374	3.79	266.54	1893	0.41
100505	800	979.3	987.03	987.3	0.001319	4.18	191.42	1038	0.33
100902	800	979.8	987.58	987.83	0.001322	3.96	201.86	43.6	0.32
101334	800	980.3	988.08	988.27	0.000791	3.49	229.4	41.5	0.26
101803	800	980.9	988.52	988.82	0.001671	4.38	182.63	64.0	0.34
101821	800	981.8	988.63	988.87	0.001294	3.9	205.19	40.0	0.3
101837	Buffham Road / Township Road 72 (bridge)								
101850	800	981.8	988.69	988.95	0.001403	4.14	193.34	79.3	0.31
101868	800	982	988.74	988.98	0.001363	3.97	201.66	170	0.31
102076	800	982	989.04	989.25	0.001212	3.69	216.89	343	0.3
102400	800	982.1	989.43	989.66	0.001249	3.85	207.77	457	0.3
102694	800	982.1	989.81	989.97	0.000858	3.19	250.93	327	0.25
103027	800	982.1	990.09	990.26	0.000826	3.29	243.26	539	0.25
103298	800	982.2	990.31	990.46	0.000646	3.02	270.85	837	0.22
103610	694	982.2	990.53	990.64	0.000553	2.77	250.53	69.9	0.2
103977	694	982.2	990.73	990.86	0.000625	2.92	237.89	113	0.21
104468	694	982.5	990.97	991.01	0.000155	1.52	456.49	229	0.11
104494	694	984	990.97	991.02	0.000221	1.75	397.61	71.4	0.13
104513	Kennard Road (bridge)								
104538	694	984	990.98	991.04	0.000326	1.95	356.05	228	0.15
104546	Kennard Road low head dam (inline structure)								
104550	694	982.4	991.03	991.06	0.000113	1.32	555.21	452	0.1
104572	694	982.4	991.04	991.06	0.000099	1.26	625.62	507	0.09
104925	694	982.5	991.08	991.08	0.000036	0.89	1307.54	542	0.06
105202	694	982.6	991.09	991.09	0.00003	0.82	1478.44	462	0.05
105570	694	982.8	991.1	991.1	0.00002	0.68	1713.99	502	0.04
106006	694	983	991.11	991.11	0.000017	0.61	2104.7	1004	0.04
106361	694	983.2	991.11	991.12	0.000011	0.49	2611.77	1457	0.03
106788	694	983.4	991.12	991.12	0.00001	0.45	2909.16	2196	0.03
107228	614	983.6	991.12	991.13	0.00001	0.41	2855.6	1495	0.03
107604	614	983.4	991.13	991.13	0	0.1	6816.47	1510	0.01
108007	614	983.2	991.13	991.13	0	0.07	9240.28	2556	0
108423	614	983	991.13	991.13	0	0.06	10911.95	2240	0
108777	614	982.9	991.13	991.13	0	0.04	13921.67	2477	0
109119	614	982.7	991.13	991.13	0	0.04	17403.24	2253	0
109528	614	982.5	991.13	991.13	0	0.03	22117.32	2891	0
110004	614	982.3	991.13	991.13	0	0.03	24116.21	3279	0
110424	614	982.1	991.13	991.13	0	0.02	28311.76	3743	0

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
110867	614	981.8	991.13	991.13	0	0.02	30874.41	4070	0
111324	614	981.6	991.13	991.13	0	0.02	32933.88	4149	0
111763	614	981.4	991.13	991.13	0	0.02	31802.02	3865	0
112196	614	981.2	991.13	991.13	0	0.02	32011.29	3590	0
112603	614	981	991.13	991.13	0	0.02	29415.74	3483	0
112955	614	980.8	991.13	991.13	0	0.03	23731.55	3002	0
113239	614	980.7	991.13	991.13	0	0.04	16344.63	2410	0
113723	507	980.5	991.13	991.13	0.000001	0.2	6088.39	1967	0.01
114169	507	980.3	991.13	991.13	0.000001	0.18	6227.13	2048	0.01
114481	507	980.1	991.13	991.13	0.000001	0.19	5671.78	1948	0.01
114579	507	981.3	991.13	991.13	0.000003	0.24	4293.61	1778	0.02
114595	Chippewa Road (bridge)								
114610	507	981.3	991.13	991.13	0.000003	0.26	3982.47	1744	0.02
114650	507	980.2	991.13	991.13	0.000002	0.2	5330.44	1912	0.01
114981	507	980.5	991.13	991.13	0.000001	0.21	5919.75	1984	0.01
115286	507	980.7	991.13	991.13	0.000001	0.18	7119.15	2273	0.01
115524	507	980.9	991.13	991.13	0.000001	0.19	6985.37	2221	0.01
115866	507	981.2	991.13	991.13	0.000002	0.21	5745.64	1939	0.01
116230	507	981.5	991.13	991.13	0.000001	0.2	5534.99	1785	0.01
116617	507	981.9	991.13	991.13	0.000002	0.21	5307.67	1806	0.01
116967	507	982.2	991.13	991.13	0.000002	0.23	4773.24	1746	0.01
117403	507	982.5	991.13	991.13	0.000003	0.26	3866.89	1477	0.02
117844	507	982.9	991.13	991.13	0.000002	0.23	3970.48	1663	0.01
118264	507	983.3	991.14	991.14	0.000005	0.3	2948.41	2068	0.02
118702	507	983.7	991.14	991.14	0.000007	0.36	2423.79	1928	0.03
119102	507	984	991.14	991.14	0.000019	0.59	1433.23	1996	0.04
119518	507	984.3	991.15	991.16	0.000038	0.74	1032.88	1925	0.06
119928	507	984.7	991.16	991.19	0.000175	1.45	417.81	1315	0.12
120308	507	985	991.22	991.27	0.000205	1.68	312.45	87.2	0.13
120638	507	985.3	991.3	991.33	0.000182	1.59	412.84	250	0.13
121061	507	985.7	991.38	991.52	0.001135	3.05	166.39	48.2	0.29
121461	507	986	991.87	992.15	0.001961	4.18	121.29	30.7	0.37
121832	507	986.3	992.68	992.99	0.002614	4.46	113.57	29.7	0.4
122201	507	986.6	993.6	993.85	0.002035	3.95	128.37	33.4	0.35
122490	507	986.9	994.17	994.4	0.00177	3.79	133.91	33.4	0.33
122723	507	987.1	994.56	994.75	0.001299	3.5	145.02	33.1	0.29
122987	369	987.3	994.88	994.94	0.000359	1.97	186.98	43.4	0.17
123050	369	987.8	994.91	994.97	0.000428	2.04	181.08	46.5	0.18

Table 2–1. Selected Hydrologic Engineers Center's River Analysis System output for Chippewa Creek, Medina, Wayne, and Summit Counties, Ohio.—Continued

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
123077	State Route 162 / Wedgewood Road (bridge)								
123099	369	987.8	994.95	995.02	0.000415	2.01	183.3	46.8	0.18
123152	369	987.5	994.98	995.04	0.000408	2.03	181.92	42.3	0.17
123373	369	988	995.1	995.21	0.001471	2.71	136.41	52.6	0.3
123677	369	988.7	995.45	995.62	0.001155	3.29	112.28	22.3	0.26
124001	369	989.4	995.82	995.97	0.001022	3.17	116.52	24.6	0.26
124338	369	990.2	996.17	996.3	0.000909	2.86	128.87	33.9	0.26

[1] Referenced to feet above mouth.

Table 2–2. Selected Hydrologic Engineers Center's River Analysis System output for Westfield Ditch, Medina County, Ohio.

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
1062	47	977.6	984.84	984.84	0.000001	0.1	812.58	1293	0.01
1446	47	977.6	984.84	984.84	0.000008	0.32	148.84	707.3	0.03
1707	47	977.6	984.84	984.84	0.000007	0.26	214.58	904.7	0.02
1739	Service Road (culvert)								
1775	47	977.5	984.86	984.86	0.000001	0.09	554.45	912.3	0.01
1864	47	977.5	984.85	984.86	0.000009	0.29	161.79	602.5	0.03
2202	47	977.7	984.86	984.86	0.000024	0.46	102.54	136.3	0.04
2525	47	977.9	984.87	984.87	0.000023	0.46	103.11	981.5	0.04
2942	47	978.1	984.87	984.87	0.000004	0.15	446.87	2931	0.02
3347	47	978.4	984.87	984.87	0.000001	0.09	755.4	1581	0.01
3765	47	978.6	984.87	984.87	0.000001	0.1	620.31	816.2	0.01
4260	47	978.9	984.87	984.88	0.000035	0.47	99.42	541.9	0.05
4296	47	978.9	984.87	984.88	0.000041	0.56	83.46	409.6	0.06
4328	Lake Road (culvert)								
4373	47	979.5	984.89	984.89	0.000029	0.48	98.83	660.4	0.05
4425	47	979.5	984.89	984.9	0.000039	0.43	112.36	650.4	0.05
4841	47	979.7	984.9	984.9	0.000008	0.23	305.74	616.8	0.03
5127	47	979.8	984.9	984.91	0.000015	0.26	267.7	696.2	0.03
5494	47	979.9	984.91	984.91	0.000013	0.27	289.36	538.5	0.03
5667	47	980	984.91	984.92	0.000073	0.7	67.2	334.3	0.07
5688	Farm field drive (culvert)								
5710	47	980.8	984.98	985	0.000164	0.98	48.18	325.1	0.11
5853	47	981.5	985.01	985.04	0.000375	1.33	35.38	232.9	0.16
6137	47	982.8	985.17	985.27	0.00194	2.52	18.65	10.76	0.34
6421	47	984.3	985.87	985.98	0.003333	2.61	18	16.64	0.44
6465	47	984.3	986.02	986.1	0.002261	2.29	20.55	17.28	0.37
6506	Buffham Road / Township Road 72 (culvert)								
6547	47	984.2	986.79	986.82	0.000542	1.29	36.57	21.79	0.17
6563	47	984.2	986.8	986.83	0.000644	1.35	34.76	21.84	0.19
6901	47	984.2	987.07	987.13	0.001224	1.96	23.96	12.69	0.25
7183	47	984.2	987.29	987.32	0.000412	1.32	35.62	14.76	0.15
7478	47	984.2	987.4	987.43	0.000332	1.22	38.62	15.5	0.14
7742	47	984.2	987.48	987.49	0.000164	0.69	67.96	42.94	0.1
8067	47	984.2	987.51	987.51	0.000049	0.43	108.31	56.22	0.06
8425	47	984.2	987.53	987.53	0.000046	0.43	110.39	55.27	0.05
8705	47	984.2	987.54	987.55	0.00011	0.74	63.6	25.75	0.08
9037	47	984.2	987.57	987.57	0.000032	0.43	108.97	40.58	0.05
9400	47	984.2	987.58	987.6	0.000291	1.11	42.33	18.8	0.13
9672	47	984.2	987.64	987.65	0.000102	0.69	68.59	29.88	0.08
9968	47	984.2	987.66	987.67	0.000051	0.5	93.24	39.35	0.06
10260	47	984.2	987.68	987.71	0.000356	1.27	36.87	13.45	0.14
10297	47	984.2	987.69	987.72	0.000351	1.27	37.05	13.47	0.13

Table 2–2. Selected Hydrologic Engineers Center's River Analysis System output for Westfield Ditch, Medina County, Ohio.—Continued

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
10334				Kennard Road (culvert)					
10370	47	986	988.65	988.67	0.000444	1.05	44.95	28.24	0.15
10394	47	986.6	988.66	988.68	0.000527	1.1	42.64	28.3	0.16
10549	47	987	988.81	988.86	0.003559	1.61	29.13	22.1	0.25
10833	47	988	989.89	989.95	0.004149	1.87	25.13	16.54	0.27
11054	47	989	990.23	990.23	0.000625	0.48	101.25	1149	0.1
11485	47	990	990.6	990.61	0.001213	0.57	89.98	789.2	0.13
11637	47	990	990.9	990.92	0.004102	1.16	40.58	546.1	0.24
11700	47	990	991.05	991.05	0.001207	0.72	65.61	348.3	0.14
11781	47	990	991.1	991.1	0.000384	0.42	110.97	120.8	0.08
11880	47	990	991.11	991.11	0.000025	0.12	395.2	744.5	0.02

[1]Referenced to feet above a point 180 feet upstream of mouth.

Table 2–3. Selected Hydrologic Engineers Center's River Analysis System output for River Styx, Medina and Wayne Counties, Ohio.

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
189	831	938	945.07	945.17	0.000387	2.47	336.25	134.4	0.18
481	831	938.1	945.19	945.28	0.000379	2.38	348.77	144.6	0.18
782	831	938.2	945.3	945.39	0.000386	2.43	342.27	136.4	0.18
1172	831	938.38	945.45	945.55	0.000409	2.49	334	136	0.19
1515	831	938.5	945.6	945.72	0.000571	2.82	294.59	131.4	0.22
1787	831	938.6	945.76	945.87	0.00054	2.73	304.78	138.5	0.21
2190	831	938.77	945.98	946.08	0.0005	2.61	318.6	150.7	0.2
2470	831	938.88	946.12	946.21	0.000384	2.43	342.55	145.7	0.18
2685	831	939	946.2	946.31	0.000518	2.69	309.35	140.9	0.21
2883	831	939.1	946.3	946.42	0.000541	2.72	305.48	58.52	0.21
3147	831	939.14	946.44	946.56	0.000536	2.77	300.49	56.77	0.21
3458	831	939.26	946.61	946.73	0.000568	2.84	292.2	56.08	0.22
3807	831	939.4	946.8	947.04	0.001136	3.87	214.88	41.15	0.3
3818	831	940.1	946.85	947.06	0.000979	3.61	229.93	44.63	0.28
3842	Railroad (bridge)								
3866	831	940.1	946.91	947.1	0.000951	3.58	232.2	44.71	0.28
3905	831	939.7	946.93	947.16	0.001094	3.87	214.51	40.64	0.3
3924	831	940.1	946.93	947.21	0.00136	4.22	196.82	38.19	0.33
3940	Salt Street (bridge)								
3957	831	940.1	946.94	947.31	0.002037	4.93	168.45	35.24	0.4
3969	831	940.1	946.98	947.34	0.002007	4.83	171.97	36.27	0.39
3990	831	940	947.22	947.42	0.000932	3.57	232.82	44.06	0.27
4003	Abandoned railroad (bridge)								
4016	831	940	947.25	947.44	0.00092	3.55	233.95	44.18	0.27
4050	831	939.9	947.27	947.48	0.001005	3.65	227.44	44.13	0.28
4078	831	940.3	947.3	947.52	0.001093	3.75	221.76	45.48	0.3
4093	Abandoned railroad (bridge)								
4109	831	940.3	947.34	947.55	0.00107	3.72	223.47	45.64	0.3
4232	831	940	947.48	947.68	0.000967	3.6	231	44.06	0.28
4291	831	940.4	947.53	947.75	0.001087	3.7	224.86	46.6	0.3
4317	Private road (bridge)								
4344	831	940.4	947.6	947.8	0.00105	3.65	227.81	46.92	0.29
4368	831	940.2	947.61	947.84	0.001153	3.84	216.16	43.19	0.3
4514	831	940.34	947.82	947.98	0.000764	3.24	256.71	47.72	0.25
4710	831	940.53	947.99	948.11	0.00054	2.81	295.22	53.97	0.21
5180	831	940.99	948.24	948.36	0.000528	2.81	295.35	106.4	0.21
5393	831	941.2	948.35	948.49	0.000617	2.98	278.71	51.73	0.23
5433	831	940.8	948.36	948.54	0.000832	3.4	244.19	46.79	0.26
5452	Pipeline / private road (bridge)								
5471	831	940.8	948.38	948.63	0.001302	3.99	208.32	44.32	0.32
5585	831	941.7	948.63	948.76	0.000533	2.86	290.99	51.19	0.21

Table 2–3. Selected Hydrologic Engineers Center's River Analysis System output for River Styx, Medina and Wayne Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
5805	831	941.7	948.76	948.87	0.000472	2.61	317.97	60.79	0.2
6097	831	941.7	948.9	949.01	0.000475	2.65	313.12	58.33	0.2
6292	831	941.7	948.98	949.14	0.000767	3.14	264.47	53.4	0.25
6358	831	942.8	949	949.25	0.001455	4.03	206.22	46.78	0.34
6372	Railroad (bridge)								
6387	831	942.8	949.05	949.3	0.001411	3.99	208.46	46.95	0.33
6451	831	941.8	949.2	949.41	0.001859	3.71	224.07	72.08	0.37
6466	831	943.2	949.27	949.44	0.000941	3.32	250.58	56.73	0.28
6490	Grant Street / East Ohio Avenue (bridge)								
6514	831	943.2	949.37	949.53	0.000886	3.24	256.16	57.26	0.27
6596	831	943.2	949.46	949.6	0.000746	3.04	273.24	57.09	0.24
6911	831	943.31	949.69	949.82	0.000623	2.91	285.27	56.99	0.23
7295	763	943.45	949.94	950.13	0.000989	3.51	217.34	45.72	0.28
7675	763	943.58	950.31	950.47	0.000789	3.22	237.14	48.12	0.26
8014	763	943.7	950.58	950.71	0.000654	2.91	261.89	54.41	0.23
8298	763	943.8	950.77	950.95	0.00091	3.42	223.38	45.56	0.27
8585	763	943.9	951.03	951.19	0.000805	3.24	235.38	47.58	0.26
8867	763	944	951.25	951.46	0.000993	3.61	211.55	41.47	0.28
8893	763	943.8	951.34	951.49	0.000834	3.18	239.81	51.76	0.26
8926	East Sunset Drive (bridge)								
8959	763	943.8	951.4	951.55	0.000816	3.14	242.92	52.62	0.26
9043	763	943.2	951.45	951.64	0.000974	3.52	216.47	43.88	0.28
9235	763	943.42	951.67	951.79	0.000559	2.82	270.09	51.1	0.22
9609	763	943.85	951.88	952.02	0.000655	3.05	250.14	46.14	0.23
9940	763	944.23	952.1	952.31	0.001013	3.63	210.02	41.15	0.28
10212	763	944.54	952.39	952.63	0.001343	3.92	194.7	42.58	0.32
10586	763	944.97	952.89	953.08	0.001073	3.53	215.92	47.47	0.29
11004	763	945.5	953.36	953.64	0.001537	4.27	178.66	36.83	0.34
11441	763	946	954.03	954.25	0.001248	3.81	200.13	45.36	0.31
11912	763	946.5	954.66	954.94	0.001631	4.26	179.02	38.86	0.35
11943	763	946.9	954.8	955	0.001116	3.63	210.27	46.16	0.3
11980	Eastern Road (bridge)								
12016	763	946.9	954.88	955.08	0.001011	3.58	213.25	43.67	0.29
12080	763	947	954.99	955.14	0.000581	3.11	245.45	48.54	0.24
12484	763	947.3	955.22	955.38	0.000569	3.2	238.4	43.43	0.24
12779	763	947.5	955.39	955.55	0.00056	3.15	242.06	44.92	0.24
13078	763	947.7	955.56	955.72	0.000588	3.25	234.89	43.42	0.25
13395	763	947.9	955.74	955.91	0.000583	3.25	234.73	42.43	0.24
13753	763	948.17	955.96	956.11	0.000558	3.11	245.04	46.74	0.24
14118	763	948.42	956.17	956.32	0.000593	3.13	243.88	48.57	0.25
14425	763	948.64	956.35	956.51	0.000609	3.23	236.14	45.22	0.25

Table 2–3. Selected Hydrologic Engineers Center's River Analysis System output for River Styx, Medina and Wayne Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
14798	763	948.9	956.59	956.76	0.000729	3.26	233.77	51.7	0.27
14828	763	948.7	956.67	956.79	0.000406	2.79	273.83	54.44	0.21
14855	Wall Road (multiple opening)								
14874	763	948.7	956.69	956.81	0.000396	2.75	277.48	109.3	0.21
14941	763	949.3	956.71	956.86	0.000645	3.16	241.64	83.02	0.26
15233	763	949.44	956.89	957.05	0.000615	3.2	238.58	47.61	0.25
15534	763	949.58	957.08	957.25	0.00071	3.31	230.4	48.2	0.27
15805	763	949.71	957.29	957.44	0.000717	3.18	240.05	56.06	0.27
16077	763	949.83	957.47	957.66	0.000812	3.47	219.58	48.45	0.29
16358	763	949.97	957.72	957.9	0.000874	3.4	224.5	49.47	0.28
16682	763	950.12	957.99	958.17	0.000821	3.39	225.04	47.15	0.27
17003	763	950.27	958.26	958.38	0.00048	2.74	280.06	64.77	0.21
17358	763	950.44	958.44	958.61	0.000814	3.33	229.46	109.9	0.26
17708	763	950.6	958.71	958.84	0.000538	2.93	278.46	743.2	0.23
17786	763	952.38	958.79	958.89	0.000359	2.51	304.45	897.1	0.18
17792.5	Low head dam (culvert)								
17801	763	952.4	959.49	959.57	0.00023	2.18	350.17	1081	0.15
17844	763	952	959.52	959.59	0.000573	2.48	555.51	759.5	0.22
18295	763	952.12	959.7	959.8	0.000362	2.57	338.43	117.6	0.19
18683	763	952.22	959.84	959.94	0.000378	2.64	296.36	517.4	0.19
19052	506	952.32	960	960.05	0.000201	1.82	285.67	744.7	0.14
19290	506	952.38	960.06	960.1	0.000163	1.65	362.69	778.1	0.13
19623	506	952.47	960.11	960.17	0.000248	1.95	268.07	1073	0.15
19909	506	952.55	960.19	960.25	0.000294	2.04	248.38	897.5	0.17
20184	506	952.62	960.27	960.39	0.000775	2.79	191.44	915.4	0.26
20478	506	952.7	960.47	960.59	0.000623	2.77	182.58	918.8	0.23
20521	506	953.7	960.57	960.63	0.000222	1.93	280.28	988.5	0.15
20547	Seville Road (bridge)								
20573	506	953.7	960.58	960.64	0.000175	1.97	274.61	1109	0.15
20648	506	953	960.58	960.68	0.000335	2.52	201.13	884.8	0.2
20843	506	953.11	960.66	960.74	0.000306	2.36	252.11	913.1	0.19
21164	448	953.29	960.78	960.83	0.000236	2.01	344.84	881.6	0.17
21395	448	953.4	960.83	960.91	0.00037	2.38	245.31	760	0.19
21718	448	953.6	960.95	961.04	0.000422	2.43	184.07	771.7	0.2
21779	448	953.9	960.95	961.1	0.000886	3.07	146.43	617.3	0.29
21792	Private drive (bridge)								
21805	448	953.9	961.07	961.18	0.000666	2.7	166.03	564	0.25
21858	448	955.2	961.16	961.22	0.000275	1.99	256.15	539.5	0.17
22235	448	955.3	961.27	961.36	0.000448	2.38	192.93	83.73	0.21
22504	448	955.38	961.39	961.46	0.000309	2.17	247.53	376.1	0.18
22805	448	955.46	961.49	961.56	0.000369	2.25	207.49	78.57	0.19

Table 2–3. Selected Hydrologic Engineers Center's River Analysis System output for River Styx, Medina and Wayne Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
23068	448	955.5	961.59	961.7	0.000647	2.73	164.09	44.29	0.25
23466	448	955.6	961.89	962.02	0.001007	2.96	165.15	88.55	0.3
23937	448	955.77	962.42	962.57	0.001336	3.22	187.63	486.7	0.34
24408	448	955.9	963	963.17	0.001217	3.33	144.51	350.3	0.31
24747	448	956.43	963.44	963.51	0.000841	2.47	290.08	282.7	0.25
25107	448	957	963.72	963.77	0.000592	2.17	306.97	239.1	0.22
25507	448	957.6	963.97	964.12	0.001241	3.22	152.79	66.82	0.31
25771	448	958.02	964.32	964.41	0.000939	2.77	334.34	1020	0.27
26148	425	958.6	964.65	964.74	0.000773	2.57	208.96	521.7	0.25
26554	425	959.23	964.93	964.99	0.000504	2.18	265.9	444.6	0.21
26830	425	959.66	965.06	965.14	0.000595	2.35	190.49	183.5	0.22
27240	425	960.3	965.35	965.5	0.001219	3.11	146.72	56.64	0.29
27268	425	960.9	965.35	965.6	0.002808	4.11	112.8	64.46	0.4
27304	Greenwich Road (multiple opening)								
27341	425	960.9	965.84	966.11	0.003869	4.29	107.93	72.53	0.48
27375	425	960.5	965.94	966.21	0.002201	4.15	102.3	30.74	0.37
27585	425	960.72	966.44	966.62	0.001725	3.48	121.99	43.64	0.37
27996	425	961.1	967.1	967.27	0.001436	3.36	126.59	41.35	0.34
28376	425	961.5	967.57	967.67	0.000765	2.56	174.07	69	0.25
28851	425	962	967.99	968.19	0.001481	3.56	119.28	32.7	0.33
29243	425	962.4	968.66	968.83	0.001789	3.31	132.39	63.29	0.35
29710	425	962.9	969.33	969.5	0.001181	3.3	128.91	33.5	0.3
29840	425	963.9	969.51	969.74	0.002314	3.82	111.13	39.49	0.4
29900	Interstate Route 76 / State Route 224 (bridge)								
29960	425	963.9	969.83	970.03	0.001926	3.51	121.08	42.62	0.37
30076	425	964.1	970.06	970.21	0.001263	3.19	133.06	128.5	0.3
30338	425	964.54	970.44	970.68	0.002337	3.88	111.23	45.71	0.4
30611	425	964.99	971.21	971.44	0.003415	3.92	112.1	61.48	0.45
30815	425	965.33	971.79	971.98	0.00205	3.5	133.41	74.27	0.37
31166	379	965.91	972.37	972.5	0.001068	2.96	145.14	671.7	0.28
31480	379	966.43	972.65	972.72	0.000493	2.24	189.13	877.9	0.2
31721	379	966.83	972.79	972.91	0.001134	2.87	166.63	318.3	0.28
31989	379	967.28	973.16	973.36	0.002398	3.52	110.76	77.64	0.39
32162	379	967.57	973.56	973.7	0.001638	2.98	128.05	53.88	0.32
32371	379	967.91	973.9	974.03	0.00148	2.86	133.8	58.79	0.31
32664	379	968.4	974.26	974.35	0.000826	2.35	164.12	767.1	0.24
32671	379	968.4	974.3	974.36	0.00055	2.02	205.03	791.9	0.19
32680	379	969.3	974.32	974.36	0.000398	1.72	236.09	814.2	0.16
32693	379	969.1	974.32	974.38	0.000542	2.01	221.55	861.7	0.19
32695	379	969.1	974.32	974.38	0.00058	2.1	203.7	703.4	0.19
32958	379	969.3	974.5	974.66	0.001801	3.19	118.99	312.7	0.34

Table 2–3. Selected Hydrologic Engineers Center's River Analysis System output for River Styx, Medina and Wayne Counties, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
33199	379	969.5	974.93	975.1	0.001845	3.3	114.73	529.3	0.35
33442	379	969.64	975.36	975.47	0.001289	2.8	149.13	99.31	0.29
33903	379	969.98	976.03	976.27	0.002207	3.94	96.32	442.1	0.38
34071	379	970.1	976.4	976.51	0.000912	2.69	141.26	137.6	0.25
34515	379	971.1	976.92	977.08	0.001775	3.19	123.18	59.99	0.34
34795	379	971.7	977.36	977.47	0.001153	2.72	139.24	47.47	0.28
35185	379	972.6	977.87	978.03	0.00172	3.18	125.13	57.75	0.33
35551	379	973.44	978.63	978.89	0.003146	4.11	92.14	249.4	0.45
35778	379	973.95	979.31	979.52	0.002386	3.65	103.93	106.3	0.39
36015	379	974.48	979.79	979.9	0.001135	2.72	139.13	47.29	0.28
36301	379	975.13	980.1	980.21	0.001032	2.73	139.15	130.7	0.27
36646	265	975.9	980.43	980.49	0.000556	1.96	142.65	102.9	0.2
36910	265	976	980.59	980.67	0.00077	2.2	120.34	57.67	0.23
36936	265	975	980.66	980.69	0.000182	1.38	192.55	60.23	0.11
36964	Blake Road (multiple opening)								
36992	265	975	980.75	980.79	0.000227	1.58	167.9	51.58	0.12
37044	265	974.6	980.75	980.83	0.000721	2.27	116.81	43.73	0.22
37421	265	975.58	981.08	981.17	0.001128	2.44	108.56	42.2	0.27
37772	265	976.5	981.53	981.69	0.001868	3.22	82.21	30.35	0.35
37784	265	977.04	981.64	981.73	0.000688	2.33	113.86	29.84	0.21
37798	Private drive (culvert)								
37813	265	976.6	981.87	981.93	0.000481	2.05	129.15	29.9	0.17
37836	265	976.9	981.87	981.97	0.0011	2.5	106.02	39.71	0.27
38096	265	976.96	982.13	982.22	0.000889	2.42	109.37	39.84	0.26
38378	265	977.02	982.41	982.53	0.001321	2.83	95.04	45.26	0.3
38754	265	977.1	982.8	982.87	0.000621	2.15	127.56	54.15	0.22
38787	265	977.5	982.85	982.88	0.000145	1.5	185.57	88.23	0.12
38811	265	976.5	982.85	982.89	0.000371	1.76	158.03	55.79	0.15
39074	265	977.34	982.95	983.1	0.00163	3.13	84.75	29.27	0.32
39267	265	977.96	983.29	983.4	0.00146	2.69	103.65	62.46	0.31
39530	265	978.8	983.65	983.74	0.00108	2.4	110.36	48.14	0.28
39810	265	979.7	983.87	983.92	0.000426	1.86	157.63	85.43	0.18
40142	265	980	984.05	984.26	0.002764	3.71	71.42	30.3	0.43
40484	265	980.3	985.08	985.18	0.002598	2.83	123.94	225.7	0.38
40773	265	980.56	985.56	985.64	0.001069	2.29	120.69	70.69	0.27
41022	265	980.78	985.83	985.99	0.001567	3.19	83.15	27.89	0.33
41373	265	981.09	986.59	986.7	0.002746	2.87	111.2	334	0.39
41721	265	981.4	987.15	987.2	0.000838	1.95	172.88	288.9	0.23
41948	265	981.6	987.31	987.37	0.000651	2.11	137.44	197.8	0.22
42001	265	981.9	987.33	987.42	0.000743	2.37	111.98	34.84	0.23

Table 2–3. Selected Hydrologic Engineers Center's River Analysis System output for River Styx, Medina and Wayne Counties, Ohio.—Continued

[ft^3/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft^2, square feet]

River station[1]	Streamflow (ft^3/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft^2)	Top width (ft)	Froude number in channel
42033	State Route 57 / Wadsworth Road (bridge)								
42065	265	981.9	987.38	987.47	0.000714	2.33	113.72	44.86	0.23
42168	265	982	987.49	987.54	0.000479	1.84	145.31	282.1	0.19
42355	265	982.3	987.56	987.7	0.001221	3.05	86.9	25.11	0.29
42674	265	982.81	988.11	988.3	0.002995	3.51	83.57	345.5	0.42
42925	265	983.21	988.66	988.75	0.001159	2.39	116.28	78.08	0.28
43167	265	983.6	988.83	988.86	0.000227	1.46	182.22	51.75	0.13

[1]Referenced to feet above mouth.

Table 2–4. Selected Hydrologic Engineers Center's River Analysis System output for Little Chippewa Creek, Wayne County, Ohio.

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
68	875	939.5	951.29	951.35	0.0002	2.03	463.84	582.3	0.13
349	875	940.39	951.34	951.42	0.00026	2.29	386.03	685.3	0.15
557	875	941.05	951.39	951.48	0.000329	2.35	375.99	829.6	0.16
824	875	941.9	951.48	951.63	0.0008	3.13	281.23	707.1	0.25
886	875	941.6	951.57	951.68	0.000415	2.68	332.94	591.6	0.19
927	South Main Street (multiple opening)								
965	875	941.6	951.62	951.73	0.000403	2.66	336.37	146.1	0.19
1015	875	941.6	951.62	951.77	0.000692	3.07	286.6	303.4	0.24
1326	875	941.66	951.83	951.92	0.000326	2.43	359.81	385	0.16
1516	875	941.7	951.89	951.98	0.000289	2.36	371.02	722.9	0.16
1721	875	941.74	951.95	952.04	0.000303	2.42	363.37	682.2	0.16
1942	875	941.78	952.02	952.1	0.000251	2.29	384.43	1225	0.15
2251	875	941.84	952.1	952.19	0.000295	2.43	362.47	753.7	0.16
2515	875	941.9	952.18	952.26	0.000252	2.26	451.37	2114	0.15
2799	875	941.95	952.28	952.32	0.000169	1.87	685.06	2087	0.12
3029	875	942	952.33	952.36	0.000131	1.65	900.4	2368	0.11
3260	875	942.04	952.35	952.41	0.000251	2.16	612.83	2531	0.15
3553	875	942.1	952.41	952.52	0.000445	2.65	388.01	2171	0.19
3597	875	942.5	952.43	952.54	0.000409	2.62	388.02	1930	0.19
3613	Private road (bridge)								
3631	875	942.5	952.45	952.55	0.000403	2.6	392.78	1803	0.18
3717	875	941.7	952.48	952.6	0.000479	2.76	375.92	1823	0.2
3875	875	941.76	952.58	952.65	0.000208	2.11	482.89	2552	0.14
4200	875	941.89	952.65	952.73	0.000239	2.26	387.89	2773	0.15
4565	875	942.04	952.74	952.84	0.000381	2.64	331.31	2768	0.18
4920	772	942.18	952.88	952.97	0.000299	2.37	325.61	1847	0.16
5306	772	942.33	953	953.07	0.000248	2.21	349.4	2722	0.15
5588	772	942.45	953.06	953.15	0.00029	2.4	322.06	3193	0.16
5990	772	942.61	953.19	953.28	0.00034	2.47	312.39	3600	0.17
6349	772	942.75	953.31	953.38	0.000232	2.13	363.25	3255	0.14
6778	772	942.92	953.42	953.53	0.000448	2.71	284.37	3126	0.19
6976	772	943	953.5	953.65	0.000716	3.17	243.78	2876	0.23
7357	772	943.15	953.74	953.84	0.000339	2.5	308.55	4698	0.17
7637	772	943.26	953.84	953.95	0.000398	2.64	292.15	3594	0.18
8024	772	943.42	953.99	954.1	0.000394	2.64	292.55	2388	0.18
8386	772	943.56	954.15	954.24	0.000377	2.48	310.94	3595	0.18
8713	772	943.69	954.26	954.38	0.000437	2.72	289.6	3385	0.19
8972	772	943.79	954.38	954.5	0.000455	2.79	277.13	3074	0.19
9304	772	943.92	954.53	954.68	0.000586	3.07	251.42	3645	0.21
9579	772	944.03	954.69	954.89	0.00093	3.58	215.34	3981	0.25
9852	772	944.14	954.95	955.09	0.000551	2.99	258.56	3710	0.21

Table 2–4. Selected Hydrologic Engineers Center's River Analysis System output for Little Chippewa Creek, Wayne County, Ohio.—Continued

[ft³/s, cubic feet per second; ft, feet; ft/ft, foot per foot; ft/s, feet per second; ft², square feet]

River station[1]	Streamflow (ft³/s)	Minimum elevation in channel (ft)	Water-surface elevation (ft)	Energy grade elevation (ft)	Energy grade slope (ft/ft)	Mean velocity in channel (ft/s)	Flow area (ft²)	Top width (ft)	Froude number in channel
10171	772	944.27	955.12	955.27	0.000555	3.1	249.27	3392	0.2
10511	751	944.4	955.31	955.47	0.000638	3.23	232.66	3709	0.21
10805	751	944.52	955.52	955.62	0.000358	2.55	294.75	3088	0.17
11148	751	944.66	955.64	955.79	0.000623	3.08	244.18	2227	0.21
11511	751	944.8	955.87	955.96	0.000356	2.47	307.07	2289	0.17
11540	751	947.3	955.88	955.98	0.000411	2.52	298.66	2108	0.19
11597	State Route 604 / Easton Road (multiple opening)								
11634	751	947.3	955.93	956.03	0.000399	2.5	301.51	3194	0.18
11673	751	946.2	955.94	956.1	0.000861	3.23	232.53	2967	0.25
11865	751	946.35	956.11	956.21	0.000344	2.46	312.15	940.1	0.17
12065	751	946.51	956.18	956.29	0.000397	2.64	287.14	683.7	0.19
12195	751	946.61	956.23	956.34	0.000369	2.57	296.68	589.7	0.18
12305	751	946.69	956.27	956.38	0.000412	2.63	288.24	111.8	0.19
12705	751	947.01	956.43	956.55	0.000417	2.71	279.52	97.73	0.19
13024	751	947.26	956.57	956.68	0.0004	2.63	286.52	49.85	0.19
13251	751	947.44	956.66	956.78	0.000437	2.72	276.78	294.5	0.19
13422	751	947.57	956.73	956.86	0.000538	2.91	258.6	69.83	0.21
13573	751	947.69	956.82	956.94	0.000419	2.77	272.46	44.27	0.19
13916	751	947.96	956.97	957.1	0.00052	2.92	259.37	48.12	0.21
14336	751	948.29	957.19	957.3	0.000436	2.73	276.44	48.91	0.19
14774	751	948.63	957.38	957.51	0.000498	2.86	263.66	47.73	0.21
15231	751	948.99	957.62	957.75	0.000569	2.98	252.41	43.22	0.22
15507	751	949.2	957.78	957.89	0.000428	2.75	289.52	59.91	0.19
15805	751	949.44	957.91	958.04	0.00055	2.97	255.28	46.94	0.21
16054	751	949.63	958.05	958.15	0.000332	2.53	304.26	53.86	0.17
16328	751	949.85	958.14	958.3	0.000748	3.21	234.84	47.44	0.25
16697	751	950.13	958.42	958.59	0.000828	3.31	227.15	41.91	0.25
17040	751	950.4	958.69	958.82	0.00051	2.86	270.24	56.85	0.21
17272	751	950.58	958.81	958.98	0.000797	3.26	231.35	47.6	0.25
17552	751	950.8	959.03	959.18	0.000691	3.17	237.61	46.15	0.24
17835	751	951.03	959.22	959.36	0.00056	3.04	258.53	50.8	0.22
18186	680	951.3	959.46	959.65	0.001171	3.52	193.31	43.55	0.29

[1]Referenced to feet above mouth.

Appendix 3. Computed Water-Surface Elevations for Chippewa Creek, River Styx, and Little Chippewa Creek

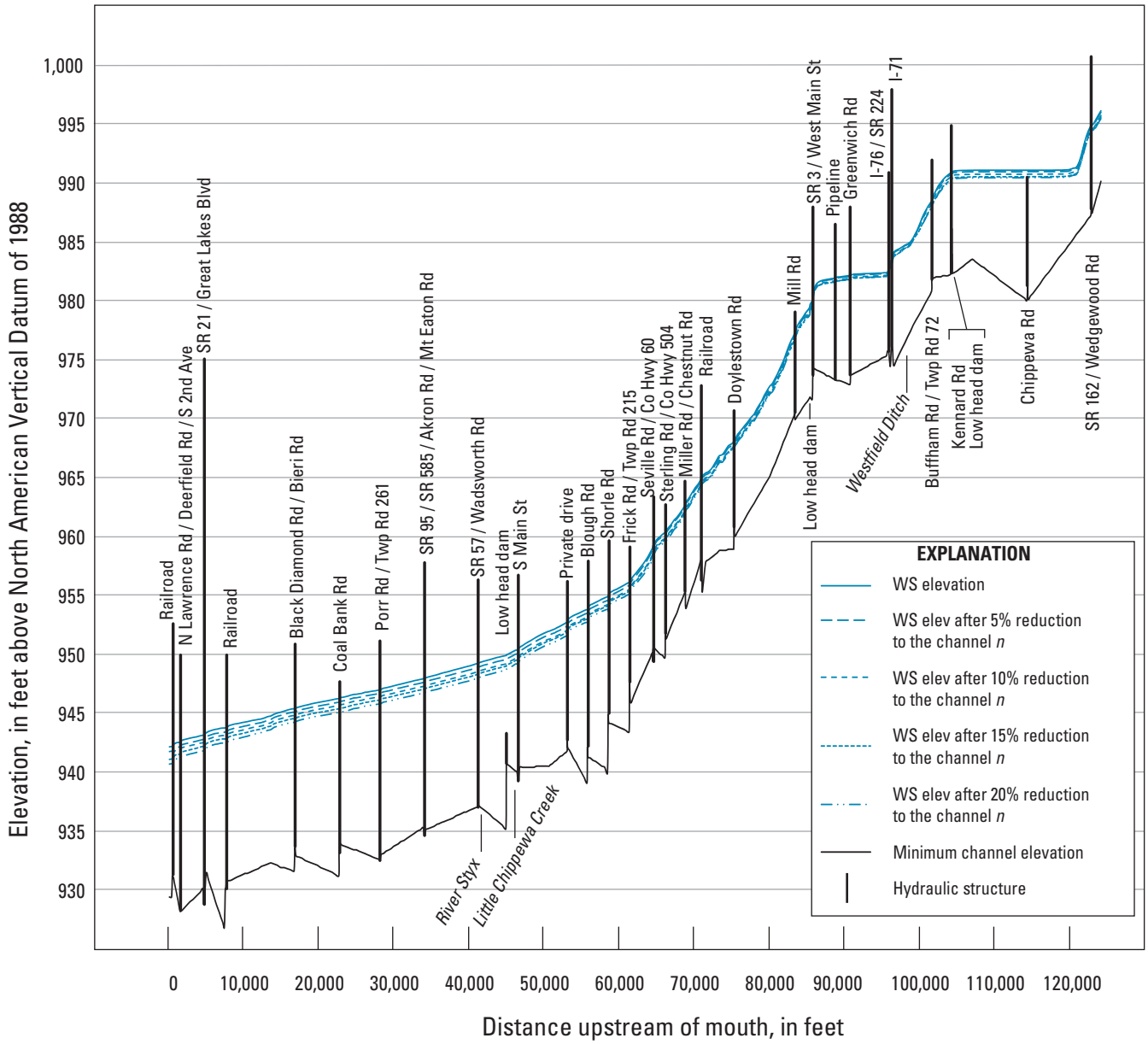

Figure 3–1. Computed water-surface profiles for a bank-full discharge with Manning's roughness coefficients in the main channel at current values and reduced by 5, 10, 15, and 20 percent on Chippewa Creek in Medina, Wayne, and Summit Counties, Ohio. (WS, water surface; %, percent; *n*, Manning's roughness coefficient)

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
369	942.18	941.8	941.58	941.13	940.67
647	942.22	941.84	941.62	941.17	940.71
751	942.23	941.85	941.63	941.17	940.7
777	942.32	941.94	941.73	941.29	940.83
914	942.35	941.97	941.76	941.32	940.86
1000	942.44	942.07	941.86	941.43	941
1288	942.53	942.17	941.96	941.54	941.11
1500	942.56	942.19	941.99	941.57	941.14
1768	942.55	942.18	941.98	941.55	941.11
1797	942.62	942.25	942.04	941.62	941.19
1845	942.66	942.29	942.08	941.67	941.23
1893	942.71	942.35	942.15	941.73	941.31
2372	942.81	942.45	942.24	941.83	941.41
2796	942.87	942.51	942.3	941.89	941.47
3092	942.92	942.56	942.35	941.95	941.53
3512	942.98	942.62	942.41	942.01	941.59
3970	943.03	942.68	942.46	942.08	941.66
4442	943.12	942.77	942.56	942.18	941.76
4834	943.17	942.82	942.6	942.23	941.79
4896	943.18	942.84	942.61	942.24	941.81
5019	943.19	942.84	942.61	942.24	941.8
5251	943.38	943.04	942.81	942.46	942.04
5582	943.5	943.16	942.93	942.58	942.17
5891	943.56	943.22	942.99	942.65	942.24
6167	943.62	943.28	943.05	942.71	942.3
6488	943.67	943.34	943.11	942.77	942.36
6760	943.7	943.36	943.13	942.79	942.38
6997	943.74	943.4	943.17	942.83	942.42
7195	943.76	943.42	943.19	942.85	942.44
7480	943.78	943.45	943.21	942.87	942.46
7669	943.78	943.44	943.2	942.86	942.45
7808	943.8	943.46	943.22	942.88	942.46
7851	943.81	943.47	943.23	942.89	942.47
7978	943.84	943.5	943.25	942.91	942.49
8289	943.98	943.64	943.39	943.05	942.64
8451	944.02	943.68	943.43	943.09	942.68
8779	944.08	943.74	943.49	943.15	942.74
9076	944.13	943.8	943.55	943.21	942.81
9390	944.15	943.82	943.57	943.23	942.83
9763	944.2	943.87	943.62	943.29	942.88
10093	944.25	943.92	943.67	943.34	942.94

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
10396	944.29	943.97	943.72	943.39	942.99
10696	944.32	944	943.76	943.43	943.03
11076	944.38	944.07	943.83	943.5	943.11
11402	944.43	944.12	943.88	943.56	943.18
11752	944.46	944.16	943.93	943.61	943.23
12175	944.51	944.21	943.97	943.66	943.29
12590	944.55	944.26	944.02	943.71	943.35
13040	944.64	944.35	944.11	943.8	943.43
13447	944.75	944.46	944.23	943.91	943.54
13837	944.8	944.52	944.28	943.96	943.59
14304	944.96	944.69	944.47	944.16	943.8
14726	945.05	944.79	944.56	944.25	943.89
15157	945.13	944.87	944.63	944.33	943.97
15635	945.22	944.95	944.72	944.41	944.04
16068	945.31	945.04	944.8	944.49	944.13
16504	945.38	945.1	944.86	944.55	944.19
16775	945.41	945.14	944.9	944.59	944.22
16962	945.41	945.13	944.88	944.57	944.2
17055	945.44	945.16	944.92	944.61	944.24
17096	945.45	945.17	944.93	944.62	944.25
17204	945.48	945.21	944.96	944.66	944.29
17595	945.57	945.3	945.05	944.75	944.38
18013	945.64	945.37	945.13	944.82	944.45
18425	945.71	945.43	945.19	944.88	944.52
18814	945.76	945.48	945.24	944.93	944.56
19226	945.83	945.55	945.31	945	944.63
19643	945.89	945.6	945.37	945.05	944.69
20055	945.94	945.65	945.42	945.1	944.74
20477	945.99	945.7	945.47	945.15	944.78
20866	946.04	945.75	945.51	945.19	944.82
21265	946.08	945.79	945.56	945.24	944.86
21658	946.13	945.83	945.6	945.27	944.9
22031	946.18	945.89	945.65	945.33	944.95
22455	946.24	945.94	945.71	945.38	945
22909	946.29	945.99	945.76	945.42	945.04
22936	946.29	945.99	945.76	945.42	945.04
22976	946.3	945.99	945.76	945.42	945.04
23070	946.37	946.06	945.82	945.47	945.07
23302	946.38	946.08	945.83	945.49	945.1
23725	946.43	946.13	945.89	945.55	945.16

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
24137	946.5	946.2	945.96	945.62	945.22
24488	946.57	946.27	946.03	945.69	945.29
24885	946.63	946.34	946.11	945.77	945.38
25238	946.65	946.36	946.13	945.8	945.41
25572	946.69	946.4	946.16	945.84	945.45
25962	946.72	946.43	946.2	945.88	945.5
26370	946.81	946.53	946.29	945.98	945.59
26704	946.83	946.54	946.31	945.99	945.61
27089	946.88	946.59	946.36	946.04	945.66
27400	946.91	946.63	946.39	946.08	945.69
27785	946.95	946.67	946.43	946.12	945.73
28246	947.01	946.72	946.47	946.16	945.77
28346	947.02	946.73	946.48	946.17	945.78
28391	947.04	946.74	946.5	946.18	945.79
28517	947.06	946.77	946.52	946.21	945.82
28861	947.16	946.87	946.62	946.32	945.93
29199	947.2	946.91	946.66	946.35	945.97
29592	947.26	946.96	946.71	946.41	946.02
29865	947.3	947.01	946.75	946.45	946.06
30191	947.36	947.06	946.8	946.5	946.11
30484	947.41	947.11	946.85	946.55	946.16
30794	947.46	947.17	946.9	946.61	946.22
31146	947.51	947.21	946.95	946.65	946.26
31578	947.58	947.28	947.01	946.71	946.32
32011	947.65	947.34	947.07	946.78	946.38
32479	947.72	947.41	947.14	946.84	946.45
32951	947.8	947.49	947.22	946.93	946.53
33360	947.85	947.54	947.27	946.98	946.58
33751	947.91	947.6	947.32	947.03	946.64
34155	947.97	947.66	947.37	947.09	946.69
34277	948	947.68	947.4	947.11	946.71
34348	948.02	947.71	947.43	947.14	946.74
34451	948.04	947.73	947.45	947.16	946.77
34776	948.11	947.79	947.51	947.23	946.83
35181	948.18	947.87	947.58	947.3	946.9
35580	948.24	947.93	947.64	947.36	946.96
36039	948.32	948	947.71	947.43	947.03
36176	948.34	948.02	947.73	947.45	947.05
36467	948.41	948.08	947.79	947.51	947.12
36932	948.49	948.17	947.87	947.6	947.2
37314	948.54	948.22	947.92	947.65	947.25

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
37739	948.62	948.29	947.99	947.72	947.31
38109	948.69	948.36	948.06	947.79	947.38
38526	948.76	948.43	948.12	947.86	947.45
38966	948.83	948.5	948.19	947.93	947.53
39294	948.88	948.55	948.24	947.98	947.58
39586	948.94	948.6	948.29	948.03	947.63
39846	948.98	948.65	948.33	948.07	947.67
40103	949.02	948.69	948.38	948.11	947.71
40426	949.07	948.74	948.43	948.16	947.76
40822	949.16	948.83	948.51	948.25	947.85
41177	949.23	948.9	948.58	948.32	947.92
41321	949.26	948.93	948.61	948.36	947.96
41377	949.28	948.95	948.63	948.38	947.98
41438	949.29	948.96	948.64	948.38	947.98
41788	949.37	949.03	948.72	948.46	948.07
42226	949.46	949.13	948.81	948.56	948.17
42620	949.52	949.19	948.87	948.62	948.23
43012	949.59	949.26	948.94	948.69	948.3
43447	949.67	949.33	949.01	948.77	948.37
43912	949.76	949.42	949.1	948.86	948.46
44302	949.81	949.48	949.16	948.91	948.52
44669	949.87	949.53	949.21	948.97	948.57
45144	949.94	949.6	949.28	949.04	948.64
45196	949.94	949.6	949.28	949.03	948.64
45206	949.99	949.65	949.34	949.12	948.72
45241	950	949.66	949.35	949.13	948.74
45664	950.13	949.8	949.49	949.27	948.88
46034	950.25	949.91	949.6	949.38	949
46409	950.38	950.05	949.75	949.53	949.16
46617	950.41	950.08	949.77	949.56	949.18
46739	950.41	950.08	949.76	949.54	949.16
46788	950.45	950.12	949.8	949.59	949.2
46970	950.64	950.32	950.02	949.82	949.46
47369	950.79	950.47	950.17	949.97	949.61
47725	950.94	950.62	950.32	950.12	949.76
48072	951.08	950.76	950.46	950.26	949.9
48466	951.21	950.89	950.59	950.39	950.04
48833	951.36	951.04	950.74	950.54	950.19
49198	951.5	951.18	950.88	950.68	950.33
49517	951.61	951.29	950.98	950.79	950.44
49843	951.72	951.4	951.09	950.9	950.55

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
50233	951.83	951.52	951.21	951.02	950.67
50677	951.96	951.65	951.34	951.16	950.81
50898	952	951.68	951.38	951.19	950.85
51026	952.03	951.71	951.4	951.22	950.87
51305	952.11	951.8	951.49	951.3	950.96
51623	952.18	951.86	951.55	951.36	951.02
51886	952.28	951.96	951.65	951.46	951.12
52294	952.41	952.08	951.77	951.59	951.24
52646	952.53	952.21	951.89	951.71	951.36
52969	952.65	952.32	952.01	951.82	951.48
53294	952.77	952.44	952.12	951.93	951.57
53311	952.77	952.44	952.12	951.93	951.58
53329	952.74	952.39	952.06	951.87	951.5
53354	952.9	952.58	952.27	952.09	951.76
53652	953.15	952.84	952.54	952.37	952.05
54107	953.32	953.01	952.71	952.54	952.22
54508	953.44	953.13	952.84	952.67	952.35
54827	953.52	953.21	952.91	952.74	952.42
55163	953.63	953.31	953.01	952.84	952.51
55585	953.76	953.44	953.14	952.97	952.64
55943	953.84	953.52	953.21	953.03	952.7
55991	953.84	953.53	953.21	953.04	952.71
56023	953.76	953.43	953.1	952.92	952.57
56061	953.98	953.67	953.38	953.21	952.9
56369	954.23	953.92	953.63	953.47	953.17
56714	954.33	954.03	953.73	953.57	953.27
57096	954.45	954.15	953.85	953.69	953.38
57512	954.58	954.26	953.96	953.8	953.49
57895	954.72	954.41	954.1	953.94	953.62
58298	954.83	954.52	954.21	954.05	953.73
58664	954.93	954.61	954.3	954.13	953.81
58758	954.93	954.61	954.29	954.12	953.79
58789	954.86	954.53	954.19	954	953.65
58830	955.16	954.87	954.58	954.43	954.14
59197	955.35	955.07	954.78	954.62	954.33
59547	955.48	955.2	954.91	954.75	954.46
59864	955.56	955.29	955	954.84	954.54
60198	955.67	955.4	955.1	954.94	954.63
60551	955.8	955.53	955.23	955.07	954.76
60911	955.92	955.65	955.34	955.18	954.86
61169	956.02	955.76	955.45	955.28	954.97

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
61545	956.14	955.88	955.57	955.4	955.07
61584	956.14	955.88	955.56	955.39	955.06
61621	956.05	955.77	955.43	955.24	954.87
61736	956.35	956.12	955.84	955.69	955.43
62179	956.73	956.51	956.22	956.07	955.78
62569	957.02	956.81	956.51	956.35	956.05
62957	957.34	957.13	956.82	956.66	956.35
63398	957.71	957.5	957.18	957.01	956.69
63869	958.14	957.94	957.61	957.44	957.09
64302	958.63	958.44	958.1	957.93	957.57
64643	959.03	958.85	958.52	958.34	957.98
64690	959.2	959.03	958.74	958.59	958.29
64721	959.25	959.08	958.79	958.64	958.34
64754	959.25	959.08	958.78	958.62	958.32
65216	959.78	959.63	959.35	959.21	958.93
65654	960.02	959.87	959.58	959.44	959.15
65987	960.23	960.08	959.79	959.65	959.36
66321	960.35	960.19	959.89	959.74	959.43
66365	960.43	960.27	959.97	959.82	959.52
66404	960.45	960.29	959.99	959.84	959.53
66474	960.51	960.34	960.05	959.89	959.59
66782	960.83	960.66	960.4	960.22	959.95
67142	961.14	960.95	960.71	960.51	960.26
67537	961.55	961.35	961.13	960.93	960.71
67908	961.8	961.59	961.38	961.16	960.95
68280	962.14	961.92	961.73	961.5	961.3
68630	962.5	962.28	962.09	961.86	961.67
68988	962.88	962.64	962.46	962.21	962.03
69018	962.93	962.7	962.53	962.29	962.13
69044	962.97	962.74	962.57	962.34	962.17
69071	963.12	962.91	962.76	962.54	962.39
69402	963.37	963.15	962.99	962.77	962.6
69879	963.84	963.61	963.43	963.22	963.03
70316	964.26	964.04	963.86	963.67	963.47
70700	964.56	964.35	964.15	963.97	963.76
71168	965.03	964.83	964.63	964.46	964.25
71195	965.12	964.93	964.74	964.57	964.37
71253	965.26	965.07	964.88	964.72	964.53
71296	965.27	965.08	964.9	964.73	964.54
71724	965.48	965.3	965.11	964.95	964.76
72093	965.57	965.39	965.21	965.06	964.87

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
72487	965.8	965.61	965.42	965.27	965.06
72880	966.21	966.01	965.81	965.67	965.45
73271	966.64	966.44	966.25	966.12	965.9
73547	966.92	966.75	966.57	966.45	966.26
73953	967.01	966.83	966.64	966.51	966.31
74390	967.4	967.22	967.02	966.9	966.68
74746	967.75	967.57	967.38	967.27	967.07
75148	967.9	967.72	967.53	967.41	967.21
75413	968.06	967.87	967.69	967.56	967.36
75467	968.09	967.9	967.72	967.58	967.38
75500	968.11	967.92	967.74	967.6	967.39
75547	968.17	967.98	967.8	967.65	967.45
75599	968.2	968.01	967.82	967.67	967.46
75996	968.72	968.54	968.36	968.24	968.05
76467	969.07	968.89	968.71	968.59	968.39
76893	969.43	969.25	969.07	968.96	968.77
77311	969.75	969.58	969.4	969.3	969.09
77778	970.16	969.99	969.82	969.72	969.53
78188	970.43	970.26	970.08	969.98	969.78
78529	970.87	970.69	970.5	970.39	970.18
78890	971.25	971.06	970.86	970.75	970.53
79196	971.54	971.34	971.13	971.02	970.79
79526	972.02	971.81	971.61	971.49	971.26
79908	972.44	972.23	972.05	971.9	971.66
80277	972.82	972.62	972.46	972.3	972.08
80625	973.04	972.83	972.68	972.5	972.26
80996	973.5	973.3	973.15	972.96	972.73
81293	973.85	973.64	973.51	973.31	973.07
81679	974.4	974.21	974.09	973.9	973.68
82067	974.93	974.76	974.66	974.47	974.23
82428	975.56	975.4	975.3	975.09	974.84
82776	976.16	975.93	975.84	975.64	975.41
83098	976.67	976.43	976.34	976.15	975.94
83366	976.98	976.76	976.66	976.48	976.27
83536	977.27	977.06	976.94	976.78	976.58
83564	977.37	977.17	977.06	976.92	976.73
83593	977.47	977.27	977.16	977.02	976.83
83618	977.48	977.28	977.17	977.03	976.84
83936	977.93	977.74	977.61	977.46	977.28
84272	978.31	978.12	977.98	977.83	977.65
84627	978.61	978.43	978.28	978.12	977.93

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
84963	978.96	978.78	978.63	978.47	978.28
85236	979.18	979	978.85	978.68	978.49
85438	979.35	979.17	979.01	978.83	978.63
85614	979.56	979.38	979.21	979.02	978.82
85628	979.74	979.58	979.43	979.29	979.18
85913	980.02	979.86	979.7	979.54	979.41
85993	980.04	979.86	979.68	979.51	979.36
86050	980.12	979.92	979.73	979.56	979.53
86116	980.94	980.83	980.74	980.67	980.64
86475	981.48	981.37	981.27	981.18	981.13
86852	981.68	981.57	981.47	981.38	981.31
87176	981.77	981.66	981.56	981.47	981.4
87497	981.82	981.71	981.61	981.52	981.45
87827	981.86	981.75	981.64	981.55	981.48
88094	981.89	981.78	981.68	981.58	981.51
88348	981.92	981.8	981.7	981.61	981.53
88603	981.94	981.83	981.72	981.63	981.55
88898	981.96	981.84	981.74	981.64	981.57
88914	981.96	981.85	981.74	981.65	981.57
89231	982.06	981.94	981.84	981.74	981.66
89549	982.08	981.97	981.87	981.77	981.69
90013	982.12	982.01	981.9	981.8	981.72
90396	982.15	982.04	981.93	981.83	981.75
90717	982.18	982.06	981.96	981.86	981.77
90957	982.18	982.06	981.96	981.86	981.77
91024	982.18	982.06	981.95	981.86	981.77
91063	982.19	982.07	981.96	981.86	981.78
91159	982.26	982.14	982.03	981.93	981.84
91460	982.3	982.19	982.08	981.99	981.9
91741	982.31	982.2	982.1	982	981.91
92060	982.32	982.21	982.1	982.01	981.92
92386	982.33	982.21	982.11	982.01	981.92
92668	982.34	982.23	982.12	982.03	981.94
92946	982.35	982.24	982.13	982.04	981.95
93282	982.35	982.25	982.14	982.05	981.96
93622	982.36	982.25	982.15	982.05	981.97
93998	982.37	982.26	982.16	982.06	981.98
94381	982.38	982.27	982.17	982.08	981.99
94738	982.39	982.29	982.18	982.09	982.01
95133	982.4	982.3	982.2	982.1	982.02
95480	982.43	982.32	982.22	982.13	982.04

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
95792	982.43	982.32	982.23	982.13	982.05
95932	982.45	982.33	982.22	982.11	982.03
96088	982.79	982.65	982.54	982.41	982.3
96297	983.32	983.19	983.08	982.96	982.85
96450	983.48	983.36	983.25	983.12	983
96611	983.84	983.71	983.6	983.47	983.35
96732	984.15	984.03	983.9	983.77	983.64
97086	984.34	984.23	984.12	984	983.88
97525	984.47	984.36	984.26	984.14	984.02
97924	984.63	984.53	984.44	984.33	984.22
98239	984.77	984.69	984.61	984.53	984.43
98605	984.86	984.78	984.7	984.61	984.52
98991	985.05	984.97	984.91	984.82	984.73
99342	985.39	985.33	985.29	985.22	985.14
99695	985.79	985.72	985.67	985.59	985.5
100060	986.3	986.21	986.16	985.91	985.79
100505	987.03	986.94	986.89	986.51	986.35
100902	987.58	987.46	987.39	987.03	986.84
101334	988.08	987.94	987.86	987.55	987.36
101803	988.52	988.35	988.25	987.95	987.73
101821	988.63	988.47	988.37	988.08	987.87
101850	988.69	988.52	988.43	988.14	987.94
101868	988.74	988.58	988.48	988.19	987.99
102076	989.04	988.88	988.76	988.49	988.29
102400	989.43	989.26	989.13	988.87	988.66
102694	989.81	989.64	989.5	989.26	989.06
103027	990.09	989.91	989.76	989.52	989.32
103298	990.31	990.14	989.98	989.75	989.54
103610	990.53	990.35	990.19	989.96	989.76
103977	990.73	990.55	990.38	990.15	989.94
104468	990.97	990.8	990.63	990.41	990.21
104494	990.97	990.79	990.63	990.41	990.21
104538	990.98	990.8	990.63	990.41	990.21
104550	991.03	990.86	990.69	990.48	990.29
104572	991.04	990.86	990.7	990.49	990.3
104925	991.08	990.9	990.74	990.53	990.34
105202	991.09	990.91	990.75	990.54	990.35
105570	991.1	990.92	990.76	990.55	990.37
106006	991.11	990.93	990.77	990.57	990.38
106361	991.11	990.94	990.78	990.57	990.39
106788	991.12	990.95	990.78	990.58	990.4

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
107228	991.12	990.95	990.79	990.59	990.4
107604	991.13	990.95	990.79	990.59	990.41
108007	991.13	990.95	990.79	990.59	990.41
108423	991.13	990.95	990.79	990.59	990.41
108777	991.13	990.95	990.79	990.59	990.41
109119	991.13	990.95	990.79	990.59	990.41
109528	991.13	990.95	990.79	990.59	990.41
110004	991.13	990.95	990.79	990.59	990.41
110424	991.13	990.95	990.79	990.59	990.41
110867	991.13	990.95	990.79	990.59	990.41
111324	991.13	990.95	990.79	990.59	990.41
111763	991.13	990.95	990.79	990.59	990.41
112196	991.13	990.95	990.79	990.59	990.41
112603	991.13	990.95	990.79	990.59	990.41
112955	991.13	990.95	990.79	990.59	990.41
113239	991.13	990.95	990.79	990.59	990.41
113723	991.13	990.95	990.79	990.59	990.41
114169	991.13	990.95	990.79	990.59	990.41
114481	991.13	990.95	990.79	990.59	990.41
114579	991.13	990.95	990.79	990.59	990.41
114610	991.13	990.96	990.8	990.6	990.42
114650	991.13	990.96	990.8	990.6	990.42
114981	991.13	990.96	990.8	990.6	990.42
115286	991.13	990.96	990.8	990.6	990.42
115524	991.13	990.96	990.8	990.6	990.42
115866	991.13	990.96	990.8	990.6	990.43
116230	991.13	990.96	990.8	990.6	990.43
116617	991.13	990.96	990.8	990.6	990.43
116967	991.13	990.96	990.8	990.61	990.43
117403	991.13	990.96	990.81	990.61	990.43
117844	991.13	990.96	990.81	990.61	990.43
118264	991.14	990.96	990.81	990.61	990.43
118702	991.14	990.97	990.81	990.61	990.44
119102	991.14	990.97	990.81	990.62	990.44
119518	991.15	990.98	990.82	990.63	990.46
119928	991.16	990.99	990.84	990.65	990.47
120308	991.22	991.06	990.9	990.72	990.55
120638	991.3	991.13	990.97	990.79	990.62
121061	991.38	991.21	991.05	990.87	990.69
121461	991.87	991.7	991.52	991.37	991.17
121832	992.68	992.5	992.31	992.18	991.97

Table 3–1. Water-surface elevation along Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
122201	993.6	993.42	993.24	993.12	992.91
122490	994.17	993.99	993.8	993.69	993.48
122723	994.56	994.38	994.19	994.08	993.87
122987	994.88	994.71	994.53	994.43	994.24
123050	994.91	994.73	994.55	994.45	994.26
123099	994.95	994.78	994.6	994.5	994.31
123152	994.98	994.8	994.63	994.53	994.33
123373	995.1	994.91	994.72	994.61	994.39
123677	995.45	995.26	995.06	994.95	994.71
124001	995.82	995.62	995.42	995.3	995.06
124338	996.17	995.98	995.77	995.66	995.42

[1] Referenced to feet above mouth.

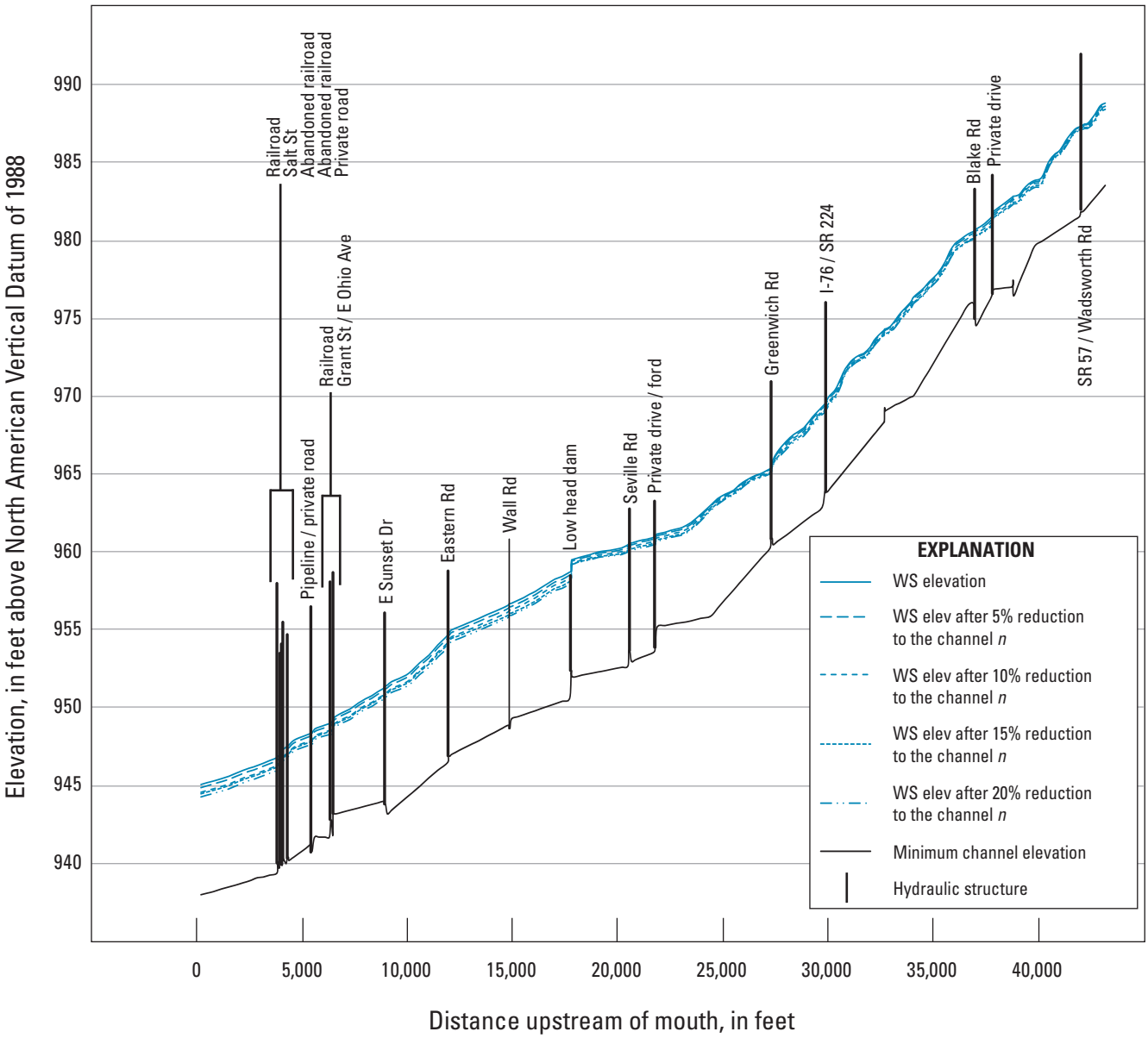

Figure 3–2. Computed water-surface profiles for a bankfull discharge with Manning's roughness coefficients in the main channel at current values and reduced by 5, 10, 15, and 20 percent on River Styx in Medina and Wayne Counties, Ohio. (WS, water surface; %, percent; *n*, Manning's roughness coefficient)

Table 3–2. Water-surface elevation, in feet, along River Styx after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
189	945.07	944.84	944.62	944.5	944.26
481	945.19	944.96	944.74	944.62	944.38
782	945.3	945.08	944.85	944.73	944.49
1172	945.45	945.23	945	944.88	944.64
1515	945.6	945.37	945.14	945.03	944.78
1787	945.76	945.53	945.31	945.19	944.94
2190	945.98	945.75	945.53	945.41	945.17
2470	946.12	945.89	945.67	945.55	945.31
2685	946.2	945.97	945.75	945.63	945.39
2883	946.3	946.08	945.85	945.73	945.49
3147	946.44	946.22	945.99	945.87	945.63
3458	946.61	946.38	946.15	946.04	945.79
3807	946.8	946.57	946.33	946.21	945.96
3818	946.85	946.63	946.39	946.27	946.02
3866	946.91	946.68	946.45	946.33	946.08
3905	946.93	946.7	946.47	946.35	946.1
3924	946.93	946.7	946.46	946.34	946.09
3957	946.94	946.7	946.46	946.33	946.07
3969	946.98	946.75	946.51	946.38	946.13
3990	947.22	947.02	946.81	946.71	946.51
4016	947.25	947.04	946.84	946.74	946.53
4050	947.27	947.07	946.86	946.76	946.55
4078	947.3	947.09	946.88	946.78	946.57
4109	947.34	947.13	946.92	946.82	946.61
4232	947.48	947.27	947.07	946.97	946.76
4291	947.53	947.33	947.12	947.01	946.8
4344	947.6	947.39	947.18	947.08	946.87
4368	947.61	947.4	947.19	947.09	946.88
4514	947.82	947.62	947.42	947.32	947.11
4710	947.99	947.79	947.59	947.49	947.29
5180	948.24	948.04	947.83	947.73	947.52
5393	948.35	948.15	947.94	947.83	947.62
5433	948.36	948.15	947.94	947.84	947.62
5471	948.38	948.17	947.95	947.85	947.62
5585	948.63	948.44	948.24	948.14	947.95
5805	948.76	948.57	948.37	948.27	948.08
6097	948.9	948.7	948.51	948.41	948.21
6292	948.98	948.78	948.58	948.48	948.27
6358	949	948.8	948.59	948.48	948.26
6387	949.05	948.85	948.64	948.53	948.32
6451	949.2	948.98	948.77	948.66	948.43
6466	949.27	949.08	948.88	948.79	948.59

Table 3–2. Water-surface elevation, in feet, along River Styx after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
6514	949.37	949.18	948.99	948.89	948.7
6596	949.46	949.27	949.09	948.99	948.8
6911	949.69	949.5	949.32	949.22	949.03
7295	949.94	949.75	949.56	949.46	949.26
7675	950.31	950.12	949.93	949.84	949.64
8014	950.58	950.4	950.21	950.11	949.92
8298	950.77	950.58	950.38	950.28	950.08
8585	951.03	950.84	950.65	950.55	950.35
8867	951.25	951.06	950.86	950.76	950.55
8893	951.34	951.14	950.95	950.85	950.65
8959	951.4	951.2	951	950.91	950.7
9043	951.45	951.25	951.05	950.95	950.74
9235	951.67	951.47	951.28	951.18	950.98
9609	951.88	951.68	951.48	951.38	951.17
9940	952.1	951.9	951.68	951.58	951.36
10212	952.39	952.18	951.96	951.85	951.62
10586	952.89	952.69	952.47	952.37	952.14
11004	953.36	953.15	952.93	952.82	952.58
11441	954.03	953.82	953.61	953.49	953.26
11912	954.66	954.44	954.21	954.09	953.85
11943	954.8	954.59	954.37	954.26	954.03
12016	954.88	954.68	954.46	954.35	954.12
12080	954.99	954.8	954.59	954.48	954.26
12484	955.22	955.01	954.81	954.68	954.47
12779	955.39	955.18	954.99	954.84	954.64
13078	955.56	955.34	955.15	955	954.79
13395	955.74	955.52	955.34	955.17	954.98
13753	955.96	955.74	955.56	955.38	955.19
14118	956.17	955.94	955.77	955.58	955.4
14425	956.35	956.12	955.95	955.75	955.57
14798	956.59	956.36	956.2	955.99	955.81
14828	956.67	956.44	956.29	956.09	955.93
14874	956.69	956.47	956.31	956.11	955.95
14941	956.71	956.48	956.32	956.12	955.95
15233	956.89	956.66	956.5	956.3	956.14
15534	957.08	956.85	956.7	956.48	956.32
15805	957.29	957.05	956.91	956.69	956.53
16077	957.47	957.24	957.1	956.88	956.72
16358	957.72	957.49	957.35	957.13	956.98
16682	957.99	957.77	957.64	957.42	957.25
17003	958.26	958.05	957.92	957.71	957.54
17358	958.44	958.22	958.09	957.87	957.69

Table 3–2. Water-surface elevation, in feet, along River Styx after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
17708	958.71	958.5	958.37	958.15	957.96
17786	958.79	958.58	958.46	958.25	958.07
17801	959.49	959.39	959.33	959.27	959.23
17844	959.52	959.41	959.34	959.27	959.23
18295	959.7	959.59	959.53	959.46	959.41
18683	959.84	959.72	959.66	959.58	959.52
19052	960	959.89	959.83	959.74	959.67
19290	960.06	959.94	959.88	959.79	959.71
19623	960.11	959.99	959.93	959.83	959.75
19909	960.19	960.06	960	959.89	959.81
20184	960.27	960.14	960.07	959.95	959.86
20478	960.47	960.34	960.26	960.14	960.03
20521	960.57	960.44	960.37	960.25	960.14
20573	960.58	960.45	960.38	960.26	960.15
20648	960.58	960.44	960.37	960.25	960.14
20843	960.66	960.52	960.44	960.32	960.2
21164	960.78	960.65	960.56	960.43	960.31
21395	960.83	960.7	960.61	960.49	960.36
21718	960.95	960.82	960.73	960.61	960.49
21779	960.95	960.82	960.73	960.61	960.49
21805	961.07	960.94	960.85	960.73	960.61
21858	961.16	961.03	960.95	960.83	960.72
22235	961.27	961.14	961.06	960.93	960.83
22504	961.39	961.26	961.18	961.05	960.95
22805	961.49	961.36	961.28	961.15	961.04
23068	961.59	961.45	961.37	961.23	961.12
23466	961.89	961.75	961.67	961.52	961.42
23937	962.42	962.31	962.25	962.12	962.02
24408	963	962.92	962.88	962.77	962.67
24747	963.44	963.35	963.31	963.2	963.09
25107	963.72	963.64	963.61	963.52	963.43
25507	963.97	963.9	963.86	963.78	963.69
25771	964.32	964.24	964.19	964.09	963.98
26148	964.65	964.61	964.58	964.51	964.42
26554	964.93	964.88	964.85	964.78	964.69
26830	965.06	965.01	964.97	964.9	964.82
27240	965.35	965.28	965.22	965.14	965.04
27268	965.35	965.27	965.2	965.12	965.01
27341	965.84	965.73	965.64	965.54	965.42
27375	965.94	965.86	965.78	965.7	965.62
27585	966.44	966.33	966.24	966.13	966.02
27996	967.1	966.97	966.88	966.75	966.6

Table 3–2. Water-surface elevation, in feet, along River Styx after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
28376	967.57	967.44	967.37	967.24	967.1
28851	967.99	967.86	967.78	967.65	967.5
29243	968.66	968.53	968.42	968.31	968.17
29710	969.33	969.2	969.09	969.01	968.87
29840	969.51	969.37	969.24	969.15	969
29960	969.83	969.69	969.55	969.46	969.3
30076	970.06	969.93	969.79	969.71	969.57
30338	970.44	970.3	970.16	970.07	969.92
30611	971.21	971.08	970.96	970.89	970.75
30815	971.79	971.7	971.61	971.56	971.47
31166	972.37	972.28	972.19	972.15	972.05
31480	972.65	972.57	972.48	972.43	972.34
31721	972.79	972.7	972.6	972.55	972.45
31989	973.16	973.08	972.99	972.93	972.84
32162	973.56	973.48	973.39	973.32	973.25
32371	973.9	973.82	973.73	973.65	973.58
32664	974.26	974.18	974.09	974.01	973.96
32671	974.3	974.21	974.13	974.05	973.99
32680	974.32	974.24	974.16	974.08	974.02
32693	974.32	974.24	974.15	974.07	974.02
32695	974.32	974.23	974.15	974.07	974.01
32958	974.5	974.41	974.31	974.22	974.15
33199	974.93	974.82	974.7	974.58	974.51
33442	975.36	975.25	975.14	975.02	974.94
33903	976.03	975.93	975.82	975.7	975.64
34071	976.4	976.3	976.2	976.09	976.03
34515	976.92	976.81	976.69	976.57	976.5
34795	977.36	977.26	977.15	977.03	976.97
35185	977.87	977.77	977.66	977.54	977.48
35551	978.63	978.52	978.4	978.27	978.2
35778	979.31	979.18	979.04	978.9	978.83
36015	979.79	979.67	979.54	979.41	979.34
36301	980.1	979.96	979.84	979.71	979.64
36646	980.43	980.29	980.17	980.05	979.99
36910	980.59	980.45	980.34	980.21	980.15
36936	980.66	980.53	980.42	980.3	980.24
36992	980.75	980.63	980.52	980.41	980.35
37044	980.75	980.62	980.51	980.4	980.34
37421	981.08	980.92	980.8	980.67	980.61
37772	981.53	981.34	981.21	981.07	981
37784	981.64	981.48	981.36	981.25	981.19
37813	981.87	981.72	981.62	981.52	981.47

Table 3–2. Water-surface elevation, in feet, along River Styx after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
37836	981.87	981.72	981.62	981.51	981.46
38096	982.13	981.99	981.89	981.78	981.71
38378	982.41	982.26	982.17	982.04	981.94
38754	982.8	982.67	982.59	982.46	982.35
38787	982.85	982.72	982.65	982.53	982.42
38811	982.85	982.72	982.65	982.52	982.42
39074	982.95	982.82	982.73	982.6	982.48
39267	983.29	983.16	983.08	982.95	982.82
39530	983.65	983.54	983.46	983.35	983.24
39810	983.87	983.76	983.69	983.59	983.48
40142	984.05	983.93	983.83	983.74	983.61
40484	985.08	984.99	984.92	984.87	984.79
40773	985.56	985.51	985.45	985.43	985.37
41022	985.83	985.76	985.69	985.65	985.58
41373	986.59	986.5	986.42	986.37	986.28
41721	987.15	987.1	987.05	987.03	986.98
41948	987.31	987.25	987.2	987.17	987.11
42001	987.33	987.28	987.22	987.2	987.13
42065	987.38	987.32	987.27	987.24	987.17
42168	987.49	987.42	987.36	987.33	987.27
42355	987.56	987.48	987.41	987.37	987.3
42674	988.11	987.97	987.86	987.81	987.69
42925	988.66	988.55	988.45	988.41	988.31
43167	988.83	988.72	988.64	988.59	988.5

[1] Referenced to feet above mouth.

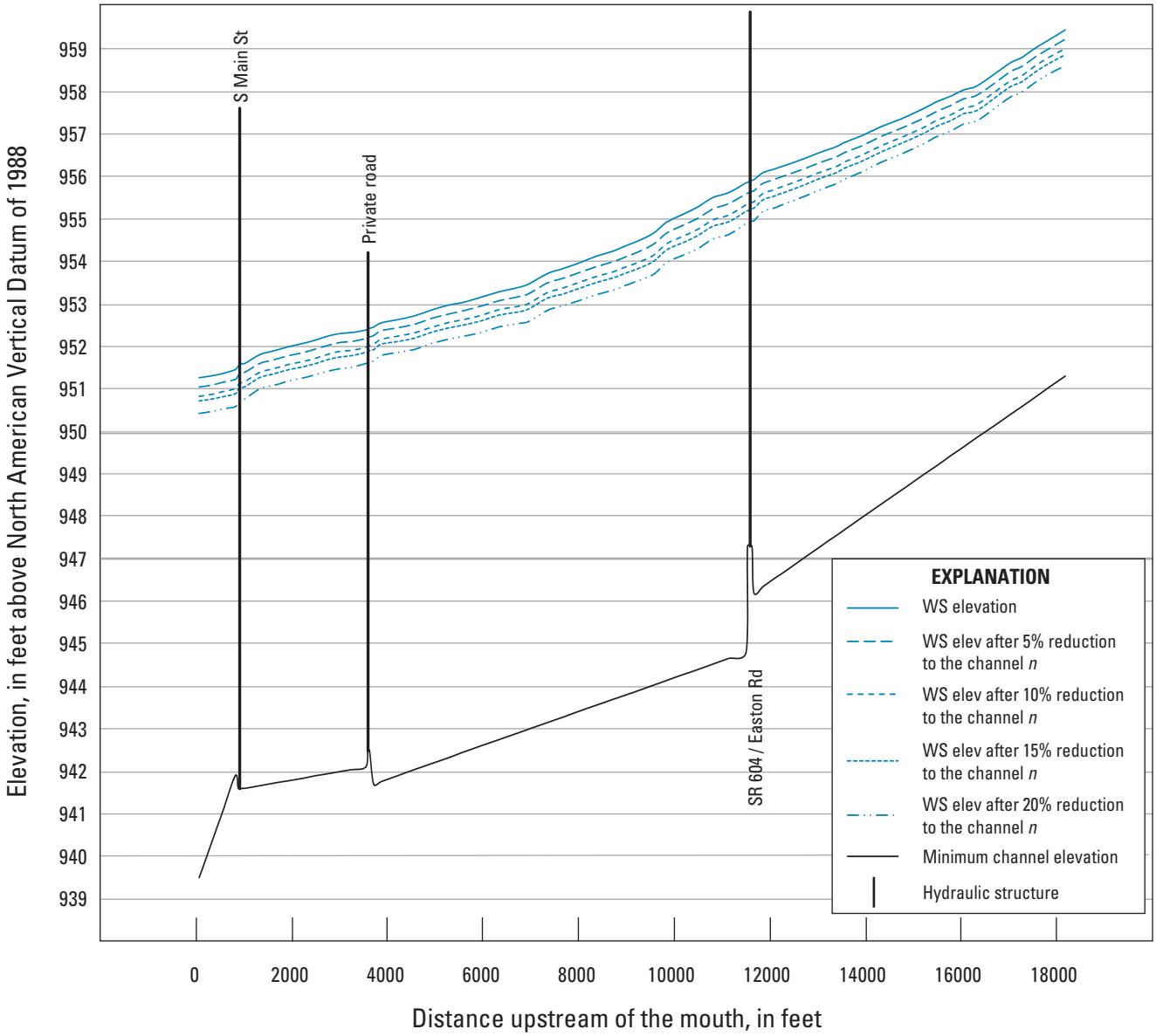

Figure 3–3. Computed water-surface profiles for a bankfull discharge with Manning's roughness coefficients in the main channel at current values and reduced by 5, 10, 15, and 20 percent on Little Chippewa Creek in Wayne County, Ohio. (WS, water surface; %, percent; *n*, Manning's roughness coefficient)

Table 3–3. Water-surface elevation, in feet, along Little Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
68	951.29	951.07	950.84	950.72	950.42
349	951.34	951.12	950.89	950.77	950.47
557	951.39	951.18	950.95	950.82	950.53
824	951.48	951.25	951.02	950.89	950.58
886	951.57	951.35	951.12	951	950.71
965	951.62	951.4	951.17	951.05	950.77
1015	951.62	951.41	951.18	951.05	950.76
1326	951.83	951.62	951.4	951.27	951
1516	951.89	951.68	951.46	951.33	951.06
1721	951.95	951.74	951.52	951.39	951.11
1942	952.02	951.81	951.59	951.46	951.19
2251	952.1	951.88	951.66	951.53	951.26
2515	952.18	951.97	951.74	951.61	951.34
2799	952.28	952.06	951.84	951.71	951.43
3029	952.33	952.12	951.9	951.76	951.48
3260	952.35	952.14	951.92	951.79	951.51
3553	952.41	952.21	951.99	951.87	951.6
3597	952.43	952.23	952.02	951.89	951.62
3631	952.45	952.25	952.03	951.91	951.63
3717	952.48	952.28	952.06	951.93	951.66
3875	952.58	952.39	952.18	952.06	951.79
4200	952.65	952.46	952.25	952.12	951.86
4565	952.74	952.54	952.33	952.2	951.93
4920	952.88	952.68	952.46	952.34	952.07
5306	953	952.79	952.58	952.45	952.18
5588	953.06	952.86	952.64	952.51	952.24
5990	953.19	952.98	952.75	952.62	952.34
6349	953.31	953.1	952.88	952.75	952.47
6778	953.42	953.2	952.96	952.83	952.55
6976	953.5	953.27	953.03	952.9	952.6
7357	953.74	953.52	953.28	953.15	952.86
7637	953.84	953.61	953.37	953.23	952.95
8024	953.99	953.76	953.52	953.38	953.09
8386	954.15	953.9	953.66	953.52	953.23
8713	954.26	954.01	953.76	953.62	953.33
8972	954.38	954.12	953.87	953.73	953.44
9304	954.53	954.27	954.01	953.87	953.58
9579	954.69	954.43	954.16	954.02	953.71
9852	954.95	954.69	954.43	954.29	953.99
10171	955.12	954.86	954.59	954.45	954.15
10511	955.31	955.04	954.77	954.63	954.32

Table 3–3. Water-surface elevation, in feet, along Little Chippewa Creek after decreasing the Manning's roughness coefficient (*n*) for the main channel by 5, 10, 15, and 20 percent.—Continued

River station[1]	Water-surface elevation (in feet) associated with the indicated decrease in the Manning's roughness coefficient (*n*) over the entire length of the main channel				
	0 percent	5 percent	10 percent	15 percent	20 percent
10805	955.52	955.25	954.98	954.84	954.54
11148	955.64	955.38	955.1	954.95	954.65
11511	955.87	955.61	955.34	955.2	954.91
11540	955.88	955.62	955.35	955.21	954.91
11634	955.93	955.67	955.4	955.26	954.97
11673	955.94	955.68	955.41	955.27	954.97
11865	956.11	955.86	955.61	955.47	955.2
12065	956.18	955.93	955.68	955.54	955.26
12195	956.23	955.99	955.74	955.6	955.32
12305	956.27	956.03	955.78	955.64	955.37
12705	956.43	956.19	955.95	955.81	955.54
13024	956.57	956.33	956.09	955.96	955.69
13251	956.66	956.42	956.18	956.05	955.79
13422	956.73	956.49	956.25	956.12	955.86
13573	956.82	956.58	956.35	956.22	955.96
13916	956.97	956.73	956.5	956.37	956.12
14336	957.19	956.96	956.73	956.6	956.36
14774	957.38	957.16	956.93	956.81	956.56
15231	957.62	957.39	957.16	957.04	956.8
15507	957.78	957.55	957.33	957.21	956.97
15805	957.91	957.69	957.46	957.34	957.1
16054	958.05	957.84	957.61	957.5	957.26
16328	958.14	957.92	957.69	957.57	957.33
16697	958.42	958.2	957.98	957.86	957.62
17040	958.69	958.48	958.25	958.14	957.9
17272	958.81	958.6	958.37	958.25	958.01
17552	959.03	958.82	958.6	958.48	958.24
17835	959.22	959.01	958.8	958.68	958.44
18186	959.46	959.24	959.01	958.89	958.64

[1] Referenced to feet above mouth.