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SEWRPC Staff Memorandum

FEASIBILITY ASSESSMENT OF DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

May 15, 2012

INTRODUCTION AND BACKGROUND

The Waterford Impoundment is located in the Village and Town of Waterford, in Racine County, Wisconsin. Concerns about sedimentation within this impounded waterway have led to the formation of a Chapter 33, public inland lake protection and rehabilitation district, known as the Waterford Waterway Management District (WWMD). The WWMD is the special purpose governmental unit tasked with managing water quality within the impounded section of the Middle Fox River between Bridge Drive in the Town of Waterford and the Waterford dam in the Village of Waterford. These waters also are within the jurisdictional area of the Southeastern Wisconsin Fox River Commission (SEWFRC), created under subchapter VI of Chapter 33 of the *Wisconsin Statutes*. A general location map is provided in Exhibit A.

During 2011, the WWMD requested the assistance of the Southeastern Wisconsin Regional Planning Commission (SEWRPC) in developing a feasibility assessment relating to the proposed dredging of the Waterway within the jurisdiction of the WWMD as set forth in the adopted comprehensive lake management plan for the Waterford Impoundment,[1] and in the implementation plan for the SEWFRC.[2] These plans noted the accumulation of unconsolidated sediments within the Impoundment, especially in the area of the Impoundment locally known as Conservancy Bay. This area limited the passage of water and watercraft between the Wisconsin Department of Natural Resources (WDNR) public recreational boating access site at Bridge Drive and the main body of the Impoundment, as noted in a 1995 survey of the Middle Fox River conducted by SEWRPC staff.[3] Subsequent to

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[1]*SEWRPC Community Assistance Planning Report No. 283,* A Lake Management Plan for the Waterford Impoundment, Racine County, Wisconsin, *Volume One,* Inventory Findings, *and, Volume Two, Alternative and Recommended Plans, October 2007.*

[2]*SEWRPC Memorandum Report No. 199,* Southeastern Wisconsin Fox River Commission Implementation Plan: 2011-2020, *September 2011; see also SEWRPC Memorandum Report No. 102,* Water Level Control Plan for the Waterford-Vernon Area of the Middle Fox River Watershed, Racine and Waukesha Counties, Wisconsin*, March 1995; and, SEWRPC Planning Program Report,* Southeastern Wisconsin Fox River Commission Water Resources Implementation Plan, March 1998, *March 1998.*

[3]*SEWRPC Memorandum Report No. 102,* op. cit.

the large floods of 2008,[4] the WWMD reported considerable additional movement of sediment into the Impoundment.[5] Riparian residents along the riverbanks immediately north of Bridge Drive noted that flood waters accumulated on their lands to an elevation greater than they had experienced during previous high water conditions, reporting such conditions to the WDNR, Racine County, Town of Waterford, and WWMD. Responding to the request of the WWMD for assistance in documenting the volume of unconsolidated sediment within the Waterway as a possible contributing factor to the reported flooding, SEWRPC staff conducted a further evaluation of the navigability within the Waterford Impoundment during spring and summer of 2011. This survey was undertaken, in part, in parallel to a survey of the Middle Fox River conducted for the refinement of the implementation plan for the SEWFRC.[6] The purpose of these surveys was to evaluate the feasibility of sediment management as an element in facilitating navigational access to and from the Waterford Impoundment and in minimizing perceived flooding risks upstream.[7]

METHODOLOGY

The SEWRPC staff, in cooperation with Commissioners from the WWMD and SEWFRC, undertook a series of measurements of water depth and sediment depth along transects from Bridge Drive to the Waterford Dam. At each site, a polyvinylchloride (PVC) pipe of approximately one-inch diameter with end cap was used to measure the depth of water between the water surface and the top of the sediment, and the depth of sediment from the bottom of the water column to a depth at which it was no longer possible to insert the rod. This depth was recorded as the total depth, from which the depth of unconsolidated sediment was calculated as the difference between the total depth and the water depth. Transects of the River and Impoundment were located to acquire sufficient cross-sectional information for estimating the potential volume of unconsolidated sediment to be considered for removal to facilitate water flow and navigation within the Impoundment.

The initial survey was undertaken in early May 2011, with supplementary measurements being obtained during early September 2011. These supplemental measurements were obtained to better refine the estimated sediment volumes to be considered for dredging, especially in the Buena Lake portion of the Impoundment. In addition, qualitative information derived from a River survey conducted under the auspices of the SEWFRC implementation plan update planning program, in September 2010, was utilized to the extent necessary to evaluate conditions upstream of Bridge Drive, within the jurisdiction of the SEWFRC.[8] These latter data also were contrasted with observations of the Middle Fox River reported in the initial SEWFRC implementation plan.[9]

The locations of the various sampling points utilized by SEWRPC staff during this survey were geo-located using a global positioning system (GPS), and transferred onto either digital orthophotographs obtained by SEWRPC in March 2010 or aerial photographs obtained by the WDNR in June 2011. The WDNR photographs being taken during a period when the Impoundment was drawn down to facilitate repair of the dam structure. Plotting of the

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[4] *F.A. Fitzpatrick, M. C. Peppler, J.F. Walker, W.J. Rose, R. J. Waschbusch, and J.L. Kennedy,* Flood of June 2008 in Southern Wisconsin*, Scientific Investigations Report No. 2008-5235, 2008.*

[5] *SEWRPC Community Assistance Planning Report No. 283, Volume One,* op. cit.

[6] *SEWRPC Memorandum Report No. 199,* op. cit.

[7] *SEWRPC Memorandum Report No. 102,* op. cit.*; SEWRPC Community Assistance Planning Report No. 283, Volume Two,* op. cit.

[8] *SEWRPC Memorandum Report No. 199,* op. cit.

[9] *SEWRPC Memorandum Report No. 102,* op. cit.

measurement points on the WDNR aerial photographs of the drawn down Impoundment confirmed the locations of the main channel and thalweg of the Impoundment vis-à-vis the field measurements and resultant cross-sections.

RESULTS

During May 2011, SEWRPC staff obtained 361 soundings across 41 transects. Transects were initiated immediately south of Bridge Drive in the Town of Waterford, and were repeated at intervals to a location immediately north of the spillway and fixed crest dam in the Village of Waterford (see Exhibit B). An additional 22 soundings were obtained during September 2011 by SEWRPC staff along eight transects (see Exhibit B). The water levels in the impoundment are measured relative to a local datum at a gauge located on the western wingwall of the dam. An elevation of 1.60 feet on the local gauge is indicated as the normal surface water elevation of the Impoundment pursuant to the dam operating permit. During the course of the survey, water surface levels in the Impoundment varied slightly, but the average water surface elevation was 1.50 feet local datum. Thus, all soundings were standardized to an average water surface elevation of 1.50 feet local datum. Local gauge readings were obtained twice daily by Racine County staff, once in the early morning at about 07:30 hours and once in the afternoon at about 15:00 hours. The 07:30 water level gauge reading was used to adjust depths recorded by SEWRPC staff during the morning hours, while the 15:00 water level gauge reading was used to adjust depths recorded during the afternoon hours.

Water depths ranged from about 0.1 foot to about 8.3 feet throughout the Impoundment. Sediment depths ranged from zero to approximately 11 feet. With few exceptions, most areas of the Impoundment had measureable accumulations of unconsolidated sediment; those areas without measureable accumulations of unconsolidated sediment were primarily located between the initial transect south of Bridge Drive and the northern extreme of the area locally known as Conservancy Bay.

Based upon feedback from the electors and property owners of the WWMD at the 2011 annual meeting of the District, and upon discussions with the Commissioners of the WWMD and SEWFRC throughout the planning period, SEWRPC staff designed proposed channel dimensions that would accommodate five feet of water depth throughout the Impoundment, and a minimum navigational lane of 50 feet of water width of 5 feet depth. The 50-foot-wide by five-foot-deep channel reflects the recommended navigation lanes dimensions set forth in the WDNR guidelines for recreational boating facilities grants.[10]

The 50-foot minimum width was utilized in the riverine portion of the Impoundment, between Bridge Drive and the northern end of the portion of the Impoundment locally known as Conservancy Bay or the "widespread," and in the embayments adjacent to the main stem of the Fox River within the Impoundment (see cross-sections 1 through 3, in Exhibit C). Between the debouchment of the River into Conservancy Bay and the Waterford dam, a 100-foot width was utilized (see cross-sections 4 through 30, in Exhibit C). A side slope of 3 horizontal on 1 vertical (3H:1V) was employed in the 50-foot-wide proposed channel within the Impoundment, and a side slope of 10H:1V was employed elsewhere. The flatter side slope in the wider portions of the river was used in

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[10]*See Wisconsin Department of Natural Resources Publication No. PUB-CA-004 2010,* Guidelines for the Recreational Boating Facilities Program*, 2010: "Cost sharing for dredging of a channel may be provided only for dredging the width of a channel to a distance of 25 feet on either side of the centerline of a river or 25 feet on either side of a center channel marker in a lake. The dredging of backslopes necessary to maintain a channel width of 50 feet for a minimum of 10 years is eligible and the design slope ratio of the backslope dredging shall be commensurate with the nature of the lakebed materials. The depth of the channel dredging will be limited to the depth necessary to accommodate recreational watercraft commonly utilizing the water body. A project having greater design goals may be assisted, but the cost sharing assistance will be limited to that portion of the project related to recreational boating. This will apply to necessary survey and engineering expenses as well."*

recognition of the likely degree of wind disturbance, and the likely occurrence of boat wake disturbance within these more open areas of the Impoundment.[11] In both cases, the width of the navigational lanes was 50 feet and 100 feet, with additional distance beyond these lanes being provided by the side slopes.

Superimposing these design channel dimensions on the cross-sections obtained during the in-lake surveys, as shown in Exhibit C, identified the cross-sectional area of material that would have to be removed, if any, from each cross-section. In order to convert these areas to volume, the linear dimension was estimated as the river length, along the thalweg, between points defined as being halfway between the cross-section being assessed and the next upstream cross-section, and halfway between the cross-section being assessed and the next downstream cross-section. The cross-section being assessed was assumed to be representative of the bathymetry of the Impoundment along the lake segment defined by these points. It was found that the portion of the Impoundment between Bridge Drive and Conservancy Bay had adequate depth and width to support navigation without dredging.

Sediment volumes necessary to create a five-foot-deep, 100 foot-wide navigational channel with 10H:1V side slopes between the northern extreme of Conservancy Bay and the Waterford dam were estimated by the SEWRPC staff. Estimated sediment volumes for creation of such a channel along the thalweg of the Impoundment comprising the former bed of the Fox River between Bridge Drive and the Waterford dam, shown as the blue line on Map 1 in Exhibit C, ranged from zero cubic yards between Bridge Drive and the northern extreme of Conservancy Bay to almost 22,000 cubic yards of material within Conservancy Bay. The estimated cumulative total volume of sediment along the thalweg was 157,600 cubic yards.

Outside of the main channel, similar assessments were undertaken in nine embayments shown on Map 1 of Exhibit C adjacent to the thalweg of the Impoundment. In these areas, sediment volumes were estimated based upon the distances within the bays required to link a boating access channel to the thalweg of the Impoundment. Boating access channels were designed to serve residential lands riparian to the bays. In approximately one-half of the cases, the dredging proposals were limited to portions of the embayments adjacent to dwelling units, rather than the removal of sediment from across an entire bay. For example, in Island View Bay and Waterford Lake, the recreational boating channels are proposed to be located around the perimeter of these embayments, while in the embayments adjacent to Indian Lane in the Town of Waterford and in Elm Island Bay, two recreational boating channels—one along the northern shore and one along the southern shore—are proposed to serve riparian residents. In Buena Lake, the recreational boating channel was proposed to be located along the western shore of the Lake. This latter channel was proposed to be constructed to the 100-foot width. The total proposed volume of dredge spoil for all of the nine embayments is estimated to be approximately 225,700 cubic yards.

The total estimated volume of sediment proposed to be removed from the Waterford Impoundment, to establish a minimum water depth to support recreational boating was 383, 300 cubic yards of sediment.

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[11] *SEWRPC Community Assistance Planning Report No. 283*, *Volume One,* op. cit.*: During July 2005, approximately 1,440 watercraft were observed on and around the Waterford Impoundment. Of these, about 200 were power boats, about 500 craft were pontoon boats, about 275 were fishing boats, and 170 were personal watercraft. The balance was comprised of sailboats, rowboats, canoes, and similar nonmotorized watercraft. At the Fox River survey site [at Bridge Drive], a total of 15 watercraft was observed in use on a typical weekday compared with 69 watercraft of various types during a typical weekend day. At the Tichigan Lake survey site [on North Tichigan Road], a total of 31 watercraft were observed in use during a typical weekday compared with 94 watercraft of various types in use on a typical weekend. Other nonboating recreational uses were observed at the Tichigan Lake survey site including sunbathing, picnicking and enjoying the aesthetics provided by a waterbody.*

DISCUSSION

SEWRPC staff presented these results to the 2011 annual meeting of the WWMD. This presentation was met with general approval by the electors and property owners present at the meeting. Consequently, SEWRPC staff utilized these volumes of material to generate an estimated cost of conducting the proposed dredging project.

Preliminary Potential Dredging Costs

The estimated cost of the dredging project is based upon assumed dredging costs of about $50 per cubic yard of material, removed and disposed in a confined disposal facility (CDF) located in relatively close proximity to the areas being dredged. This unit cost is similar to actual unit costs for recent dredging projects in the Southeastern Wisconsin Region, namely projects conducted in Zastrow Bay at Nagawicka Lake and in the Inlet area of Delavan Lake. Based upon this estimated unit cost and the estimated volume of materials to be removed from the Impoundment, and adding 35 percent for engineering, administration, and contingencies, the cost of the dredging project described above would be approximately $25.9 million, or approximately $25,900 per household within the WWMD. Of this amount, approximately $10.6 million would be dedicated to the dredging of the thalweg, while the balance of $15.3 million would be dedicated to the dredging of the bays. These costs, and the associated dredged material volumes, should be refined through more detailed engineering investigations and design.

Potential Funding Mechanisms

Public inland lake protection and rehabilitation districts, such as the WWMD, have several financial mechanisms to fund their lake protection and rehabilitation programs. These include the use of tax levies, special charges, and special assessments. Of these, Section 33.32 of the *Wisconsin Statutes* foresees the use of special assessments as the principle mechanism for funding long term capital projects, such as dredging.[12] Lake Districts also can utilize borrowing as noted in Sections 33.22 and 33.31 of the *Wisconsin Statutes*, although any borrowing by a district must be repaid. The use of the special assessment is subject to the provisions of Section 66.0703 of the *Wisconsin Statutes*, which states that "as a complete alternative to all other methods provided by law, any city, town or village may, by resolution of its governing body, levy and collect special assessments upon property in a limited and determinable area for special benefits conferred upon the property by any municipal work or improvement; and may provide for the payment of all or any part of the cost of the work or improvement out of the proceeds of the special assessments." Typically, special assessments can be paid either as a single payment or over time, up to 10 years, as a lien upon a property.

That said, the potential benefit of a proposed dredging project such as that set forth above accrues not only to the riparian landowners, but also to other lake users, and upstream property owners. Consequently, the WWMD should consider additional funding mechanisms in addition to fees levied within their own jurisdiction. Examples of such revenues would include the use of grant funds and direct appropriations by other units of government having concurrent jurisdiction over the Impoundment.

Possible grant funding sources would include the Chapter NR 191 Lake Protection Grant program, which would contribute up to $200,000 State share (75 percent), and would require a $66,667 local share (25 percent). While such funding is small in comparison with the estimated total cost of the project, Chapter NR 191 of the *Wisconsin Administrative Code* does allow use of funds for project planning purposes. Similarly, Chapter NR 7 Recreational Boating Facility Grant funds also could be applied to activities related to the provision of public recreational boating access, although the degree to which such funds could be applied to the project as proposed may be limited. The fact that the portion of the Impoundment between the WDNR public recreational boating access facility at Bridge Drive and the portion of the Impoundment locally known as Conservancy Bay currently meets the recommended width and water depth requirements may limit the ability of the WWMD to access these funds.

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[12] *See University of Wisconsin-Extension Publication No. G3818,* People of the Lakes: A Guide for Wisconsin Lake Organizations, 11th Edition*, 2006.*

The contribution of the dredging project to the public health, safety, convenience, and welfare could provide a basis for partial support for a dredging project to be solicited from the general purpose units of government (the Village and Town of Waterford), the County, and the State. In terms of local government participation, it is noted that dredging projects implemented by the Little Muskego Lake Protection and Rehabilitation District within the City of Muskego have been funded through a three party funding mechanism, with funds being provided by the Lake District, the City of Muskego, and the Little Muskego Lake Association, Inc., and additional funding be provided through the Chapter NR 7 Recreational Boating Facility in certain instances (where the dredging directly benefited a public recreational boating access site). These projects were predicated upon the fact that lake users include persons other than riparian property owners. The participation of the Little Muskego Lake Association, a Federal Chapter 501(c)(3) tax exempt organization and State Chapter 181 not-for-profit corporation, brought an element of funding from the wider community to the projects.

As noted above, the Waterford Impoundment also falls within the jurisdiction of the SEWFRC, whose Statutory mandate pursuant to Section 33.57(1) of the *Wisconsin Statutes* includes, among other powers, the ability to "protect or enhance the recreational use of the navigable waters of the Illinois Fox River basin that are located in a river municipality."[13] To this end, the recommended navigational improvements for which the WWMD is seeking funding have been incorporated into the SEWFRC implementation plan. Thus, that recommendation of the SEWFRC implementation plan is consistent with the comprehensive lake management plan for the Waterford Impoundment area.[14]

Finally, direct State support for the project may be possible through a specific appropriation of the Legislature, and Federal support could potentially be accessed through the U.S. Army Corps of Engineers flood risk management, inland navigation infrastructure, and/or natural resources management/national recreational planning programs, among others. To this end, the WWMD has maintained contact with the U.S. Army Corps of Engineers with respect to participation in the U.S. Army Corps of Engineers Section 204 ecosystem restoration program.[15]

NEXT STEPS

The following actions are recommended:

1. That WWMD engage consulting engineers to refine the volumes of unconsolidated sediment and develop detailed dredging plans and specifications necessary for permitting by the WDNR pursuant to their Chapter 30, *Wisconsin Statutes*, authorities.

2. That WDNR review the proposed dredging program pursuant to State of Wisconsin environmental protection requirements as set forth in Section 30.19 (1) (g) of the *Wisconsin Statutes*, and as elaborated in Chapter NR 150 (environmental assessment, see Exhibit D), Chapter NR 180 (disposal of solid wastes), Chapter NR 200 (permitting of return flows under the Wisconsin Pollutant

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[13]*River municipality as used in Subchapter VI of Chapter 33 of the* Wisconsin Statutes *means the City of Waukesha, Villages of Big Bend, Mukwonago, and Waterford, and the Towns of Mukwonago, Vernon, Waterford, and Waukesha.*

[14]*SEWRPC Community Assistance Planning Report No. 283, Volume One, and, Volume Two,* op. cit.*; SEWRPC Memorandum Report No. 199,* op. cit.

[15]*Section 204 of the 1992 Water Resources Development Act provides authority for the U.S. Army Corps of Engineers to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized project.*

Discharge Elimination System), and Chapters NR 345 through NR 347 (dredging and removal of materials from the beds of navigable waterways), among others, of the *Wisconsin Administrative Code*.

3. That, concurrently, the WWMD review and refine costs, and seek funding, including costs for: Permit fees, Analytical costs, Engineering design costs, Disposal site and facility preparation, Equipment mobilization, and Scheduling and sequencing of actions.

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SEWRPC Staff Memorandum

FEASIBILITY ASSESSMENT OF DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

Exhibit A

LOCATION MAP AND TRANSECT LOCATIONS

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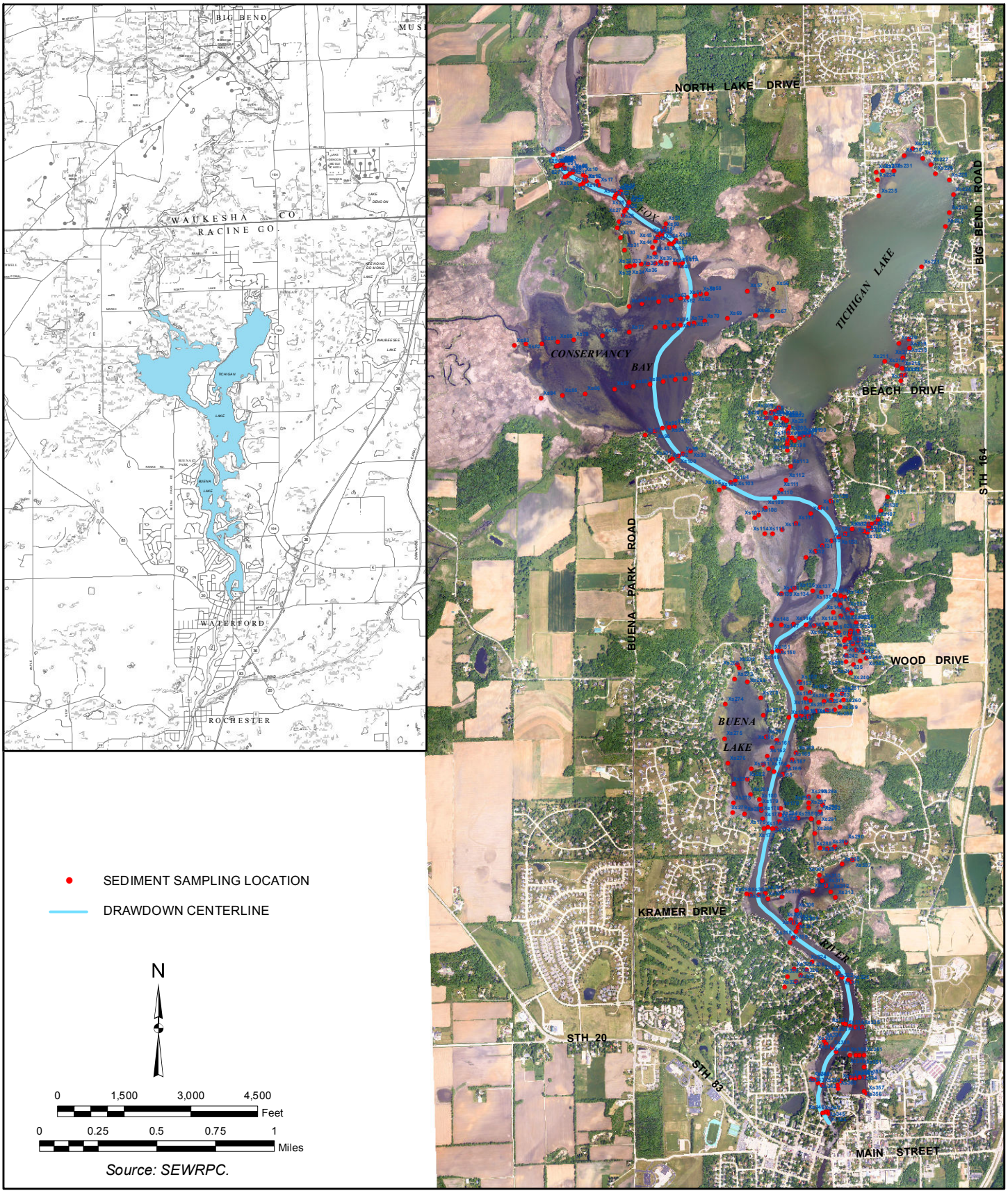
Map 1

LOCATION MAP AND SEDIMENT SAMPLING SITE LOCATION FOR THE WATERFORD WATERWAY



Source: SEWRPC.

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FEASIBILITY ASSESSMENT OF DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

Exhibit B

DATA

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Exhibit B

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs001	1.25	4.3	3.05	1.17	4.22	2.97	206	0	309	515
Xs002	1.1	5.6	4.5	1.02	5.52	4.42		51		
Xs003	7.6	9	1.4	7.52	8.92	1.32		103		
Xs004	4.8	4.8	0	4.72	4.72	0		154		
Xs005	1.4	7.25	5.85	1.32	7.17	5.77		206		
Xs006	1.6	7.4	5.8	1.52	7.32	5.72	258	0	412	515
Xs007	5.1	8.9	3.8	5.02	8.82	3.72		51		
Xs008	5.4	5.4	0	5.32	5.32	0		103		
Xs009	1.1	1.25	0.15	1.02	1.17	0.07		206		
Xs010	1.4	4.1	2.7	1.32	4.02	2.62		258		
Xs011	1.1	5.25	4.15	1.02	5.17	4.07	412	0	463	721
Xs012	5.3	8.6	3.3	5.22	8.52	3.22		154		
Xs013	5.5	7.3	1.8	5.42	7.22	1.72		309		
Xs014	4.1	7.2	3.1	4.02	7.12	3.02	309	206	51	
Xs015	1.6	2	0.4	1.52	1.92	0.32		154		
Xs016	0.8	4.8	4	0.72	4.72	3.92	618	257		
Xs017	2.8	6	3.2	2.72	5.92	3.12		412		
Xs018	1.5	1.5	0	1.42	1.42	0		0		
Xs019	3.25	5	1.75	3.17	4.92	1.67	309	0	824	618
Xs020	6.1	10.6	4.5	6.02	10.52	4.42		51		
Xs021	5.5	6.8	1.3	5.42	6.72	1.22		154		
Xs022	2.25	3.7	1.45	2.17	3.62	1.37		309		
Xs023	1.1	1.1	0	1.02	1.02	0	772	0	824	
Xs024	5.1	5.9	0.8	5.02	5.82	0.72		103		
Xs025	5.1	5.7	0.6	5.02	5.62	0.52		154		
Xs026	1.6	6.4	4.8	1.52	6.32	4.72		257		
Xs027	1.1	6.4	5.3	1.02	6.32	5.22		360		
Xs028	1.3	3.4	2.1	1.22	3.32	2.02		566		
Xs029	2.6	3	0.4	2.52	2.92	0.32		721		
Xs030	1.2	4.1	2.9	1.12	4.02	2.82	978	257		
Xs031	1.6	4.2	2.6	1.52	4.12	2.52		618		
Xs032	1.2	1.9	0.7	1.12	1.82	0.62		978		
033			0							
Xs033	1.3	4.7	3.4	1.28	4.68	3.38	1493	1493	515	
Xs034	1.4	4.6	3.2	1.38	4.58	3.18		1287		
Xs035	1.7	3.9	2.2	1.68	3.88	2.18		1134		
Xs036	1.2	2.8	1.6	1.18	2.78	1.58		978		
Xs037	0.9	4.1	3.2	0.88	4.08	3.18		721		
Xs038	1.1	4.6	3.5	1.08	4.58	3.48		618		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs039	1.2	3.6	2.4	1.18	3.58	2.38		463		
Xs040	1.1	4.6	3.5	1.08	4.58	3.48		206		
Xs042	1.7	1.7	0	1.68	1.68	0		0	566	
Xs041	5.7	8.2	2.5	5.68	8.18	2.48		103		
Xs041A	0	0	0	0	52					
Xs043	1.3	5	3.7	1.28	4.98	3.68	515	412		
Xs044	2.5	3.7	1.2	2.48	3.68	1.18	824	669	1081	927
Xs045	1.5	5.4	3.9	1.48	5.38	3.88		515		
Xs046	1.8	5.7	3.9	1.78	5.68	3.88		412		
Xs047	3.5	8.7	5.2	3.48	8.68	5.18		309		
Xs048	2.3	3.25	0.95	2.28	3.23	0.93		257		
Xs049	4.1	9.5	5.4	4.08	9.48	5.38		206		
Xs050	2.1	10	7.9	2.08	9.98	7.88		103		
Xs051	1.5	2.25	0.75	1.48	2.23	0.73		0		
Xs052	1.9	4	2.1	1.88	3.98	2.08	206	256	360	721
Xs053	4.1	9.3	5.2	4.08	9.28	5.18		154		
Xs054	5	5	0	4.98	4.98	-0.02		103		
Xs055	1.3	1.3	0	1.28	1.28	-0.02		0		
Xs056	2.25	4.3	2.05	2.23	4.28	2.03	4171	257	824	
Xs057	2.8	4.75	1.95	2.78	4.73	1.93		875		
Xs058	3.1	5.75	2.65	3.08	5.73	2.63		1854		
Xs059	2.7	4.75	2.05	2.68	4.73	2.03		2008		
Xs060	2.4	4.7	2.3	2.38	4.68	2.28		2214		
Xs61	2.3	4.9	2.6	2.28	4.88	2.58		2262		
Xs62	1.6	7.8	6.2	1.58	7.78	6.18		2472		
Xs063	2.3	4.9	2.6	2.28	4.88	2.58		2884		
Xs064	2.6	3.8	1.2	2.58	3.78	1.18		3244		
Xs065	2.6	4.5	1.9	2.58	4.48	1.88		3656		
Xs066	2.8	3.7	0.9	2.78	3.68	0.88		4017		
Xs107	1.6	3.9	2.3	1.64	3.94	2.34	1854	1648	1236	1236
Xs108	2.1	5.2	3.1	2.14	5.24	3.14		1545		
Xs109	2.3	10	7.7	2.34	10.04	7.74		2111		
Xs110	2.4	5.4	3	2.44	5.44	3.04		927		
Xs111	2.6	6	3.4	2.64	6.04	3.44		669		
Xs112	2.75	8.3	5.55	2.79	8.34	5.59		412		
Xs113	3.2	5.8	2.6	3.24	5.84	2.64		0		
Xs114	1.7	4.25	2.55	1.74	4.29	2.59	2214	1905	824	927
Xs115	2	7.1	5.1	2.04	7.14	5.14		1751		
Xs116	2.3	5	2.7	2.34	5.04	2.74		1442		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs117	2.7	5.9	3.2	2.74	5.94	3.24		1081		
Xs118	3.1	8.5	5.4	3.14	8.54	5.44		618		
Xs119	3.8	7.75	3.95	3.84	7.79	3.99		234		
Xs120	4.1	5.6	1.5	4.14	5.64	1.54		0		
Xs067	2.1	4.2	2.1	2.14	4.24	2.14	7210	412	618	1133
Xs068	2.7	4.3	1.6	2.74	4.34	1.64		875		
Xs069	3.5	5.25	1.75	3.54	5.29	1.79		1596		
Xs070	2.9	5.2	2.3	2.94	5.24	2.34		2163		
Xs071	2.75	5.7	2.95	2.79	5.74	2.99		2472		
Xs072	2.6	5.4	2.8	2.64	5.44	2.84		2575		
Xs073	1.2	7.1	5.9	1.24	7.14	5.94		2832		
Xs074	2.8	7.3	4.5	2.84	7.34	4.54		2987		
Xs075	3.3	8.5	5.2	3.34	8.54	5.24		3244		
Xs076	3.25	4.6	1.35	3.29	4.64	1.39		3502		
Xs077	3.2	5.3	2.1	3.24	5.34	2.14		4171		
Xs078	3.3	4.5	1.2	3.34	4.54	1.24		4892		
Xs79	3.75	6.9	3.15	3.79	6.94	3.19		5613		
Xs80	3.3	8.4	5.1	3.34	8.44	5.14		6025		
Xs081	3.6	6.5	2.9	3.64	6.54	2.94		6437		
Xs082	2.8	4.9	2.1	2.84	4.94	2.14		6849		
Xs083	1.75	4.7	2.95	1.79	4.74	2.99		7158		
Xs084	2.5	7.75	5.25	2.54	7.79	5.29	3914	3862	1442	2472
Xs085	3.3	6.6	3.3	3.34	6.64	3.34		3296		
Xs086	3.3	5.5	2.2	3.34	5.54	2.24		2987		
Xs087	3.75	5.75	2	3.79	5.79	2.04		1957		
xs088	3.5	5.9	2.4	3.54	5.94	2.44		1442		
Xs089	3.6	4.9	1.3	3.64	4.94	1.34		1030		
Xs090	3.3	6.9	3.6	3.34	6.94	3.64		669		
Xs091	3.3	4.9	1.6	3.34	4.94	1.64		360		
Xs092	2.9	5.25	2.35	2.94	5.29	2.39		103		
Xs093	3.6	4.5	0.9	3.64	4.54	0.94	824	25	1493	1236
Xs094	3.7	8.75	5.05	3.74	8.79	5.09		154		
Xs095	3.4	5.9	2.5	3.44	5.94	2.54		360		
Xs096	3.7	9.1	5.4	3.74	9.14	5.44		566		
Xs097	3.8	6.9	3.1	3.84	6.94	3.14		824		
Xs098	3.3	6	2.7	3.34	6.04	2.74		618	824	1236
Xs099	3.5	4.5	1	3.54	4.54	1.04		257		
Xs100	3.7	5.4	1.7	3.74	5.44	1.74		360		
Xs101	4	10	6	4.04	10.04	6.04		515		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs102	2	2	0	2.04	2.04	0.04		618		
Xs103	5	5.9	0.9	5.04	5.94	0.94	1390	0	566	1236
Xs104	4.6	10	5.4	4.64	10.04	5.44		154		
Xs105	3.7	4.7	1	3.74	4.74	1.04		360		
Xs106	1.8	3.25	1.45	1.84	3.29	1.49		515		
Xs188	1.5	4	2.5	1.6	4.1	2.6		206	1133	
Xs189	2.25	8.1	5.85	2.35	8.2	5.95		412		
Xs190	3.25	4.6	1.35	3.35	4.7	1.45				
Xs191	4.7	11	6.3	4.8	11.1	6.4				
Xs192	3.1	5.9	2.8	3.2	6	2.9				
Xs193	2.7	3.75	1.05	2.8	3.85	1.15				
Xs194	1.25	4.4	3.15	1.35	4.5	3.25				
Xs195	0.6	4.3	3.7	0.7	4.4	3.8				
Xs196	1.25	4.6	3.35	1.35	4.7	3.45		515		
Xs197	0.8	2.5	1.7	0.9	2.6	1.8		412		
Xs198	0.5	2.5	2	0.6	2.6	2.1		155		
Xs199	1.4	4.5	3.1	1.5	4.6	3.2		618		
Xs200	2.1	3.2	1.1	2.2	3.3	1.2		721		
Xs201	3.2	5.7	2.5	3.3	5.8	2.6		772		
034			0	0.1	0.1	0.1		927		
Xs202	2.5	3.7	1.2	2.6	3.8	1.3				
Xs203	0.8	2.7	1.9	0.9	2.8	2				
Xs204	1.8	1.8	0	1.9	1.9	0.1				
Xs205	3.6	6.6	3	3.7	6.7	3.1		103	562	
Xs206	2.9	5.2	2.3	3	5.3	2.4		257		
Xs207	2.8	6.3	3.5	2.9	6.4	3.6		412		
Xs005	1.4	7.25	5.85	1.5	7.35	5.95				
Xs208	3.1	3.1	0	3.2	3.2	0.1		154	360	
Xs209	3.5	5.1	1.6	3.6	5.2	1.7		103		
Xs138	3.3	5.9	2.6	3.4	6	2.7		309		
Xs139	3.3	6.1	2.8	3.4	6.2	2.9		206		
Xs140	3.4	11	7.6	3.5	11.1	7.7		51		
Xs141	3.6	11	7.4	3.7	11.1	7.5		257	1236	
Xs142	3.2	7.7	4.5	3.3	7.8	4.6		515		
Xs143	3.2	5.5	2.3	3.3	5.6	2.4		824		
Xs144	3.5	6.4	2.9	3.6	6.5	3	1390	257	1236	1133
Xs145	3.75	11	7.25	3.85	11.1	7.35		463		
Xs146	2.8	4.1	1.3	2.9	4.2	1.4		772		
Xs147	3.8	4.75	0.95	3.9	4.85	1.05		1133		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs148	2.2	5.5	3.3	2.3	5.6	3.4		1390		
Xs149	1.3	5.4	4.1	1.4	5.5	4.2	309	0	824	
Xs150	8.25	10.4	2.15	8.35	10.5	2.25		103		
Xs151	3.7	5.8	2.1	3.8	5.9	2.2		257		
Xs152	1.5	6.5	5	1.6	6.6	5.1	1339	412	1236	
Xs153	1.8	4.9	3.1	1.9	5	3.2		618		
Xs154	2.6	11	8.4	2.7	11.1	8.5		875		
Xs155	2.8	11	8.2	2.9	11.1	8.3		1081		
Xs156	2.3	2.3	0	2.4	2.4	0.1		1339		
Xs157	3.75	7.1	3.35	3.85	7.2	3.45	412	0	1699	1854
Xs158	5.1	7.2	2.1	5.2	7.3	2.2		103		
Xs159	3.4	3.4	0	3.5	3.5	0.1		360		
Xs160	2.3	3.8	1.5	2.4	3.9	1.6		824		
Xs161	2.4	4.9	2.5	2.5	5	2.6		257		
Xs162	1.9	5.1	3.2	2	5.2	3.3		463		
Xs163	1.9	3.75	1.85	2	3.85	1.95	618	566	1751	
Xs164	2.6	9.2	6.6	2.7	9.3	6.7		412		
Xs165	4.25	4.3	0.05	4.35	4.4	0.15		257		
Xs166	3.1	3.1	0	3.2	3.2	0.1		51		
Xs167	2.4	4.1	1.7	2.5	4.2	1.8	721	463		
Xs168	2.3	3.7	1.4	2.4	3.8	1.5		257		
Xs169	1.1	3.1	2	1.2	3.2	2.1		51		
Xs170	1.9	2.6	0.7	2	2.7	0.8				
Xs171	2.25	4	1.75	2.35	4.1	1.85				
Xs172	2.5	6.6	4.1	2.6	6.7	4.2				
Xs173	4.6	5.75	1.15	4.7	5.85	1.25	412	0	1493	
Xs174	4.2	6.25	2.05	4.3	6.35	2.15		103		
Xs175	5.7	8.9	3.2	5.8	9	3.3		257		
Xs176	3.75	3.75	0	3.85	3.85	0.1		412		
Xs177	4.2	5.3	1.1	4.3	5.4	1.2	721	515		
Xs178	3.3	5.4	2.1	3.4	5.5	2.2		154		
Xs179	2.5	5.3	2.8	2.6	5.4	2.9		0		
Xs180	1.6	1.9	0.3	1.7	2	0.4				
Xs181	1.6	4.4	2.8	1.7	4.5	2.9				
Xs182	1.8	4.5	2.7	1.9	4.6	2.8				
Xs183	1.3	4	2.7	1.4	4.1	2.8				
Xs184	1.4	2.7	1.3	1.5	2.8	1.4		206	1133	
Xs185	0.5	2.75	2.25	0.6	2.85	2.35		206		
Xs186	1.4	3.75	2.35	1.5	3.85	2.45		103		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs187	1.75	4.7	2.95	1.85	4.8	3.05		103		
Xs210	3.5	4.2	0.7	3.6	4.3	0.8		360		
Xs211	4.25	4.7	0.45	4.35	4.8	0.55		824	824	
Xs212	3.1	4.2	1.1	3.2	4.3	1.2		669		
Xs213	1.7	2.7	1	1.8	2.8	1.1		515		
Xs214	3.3	4.25	0.95	3.4	4.35	1.05		309		
Xs215	2.75	3.7	0.95	2.85	3.8	1.05		103	1030	
Xs216	2.75	3.2	0.45	2.85	3.3	0.55		257		
Xs217	3.3	4.2	0.9	3.4	4.3	1		515		
Xs218	3.6	5.3	1.7	3.7	5.4	1.8		772		
Xs219	2.2	4.7	2.5	2.3	4.8	2.6		1030		
Xs220	3	3	0	3.1	3.1	0.1		1133		
Xs221	3.9	3.9	0	4	4	0.1		0	5562	
Xs222	5.75	7.75	2	5.85	7.85	2.1		1236		
Xs223	6.1	7.5	1.4	6.2	7.6	1.5		1493		
Xs224	4.6	4.8	0.2	4.7	4.9	0.3		1596		
Xs225	3.1	3.1	0	3.2	3.2	0.1		2111		
Xs226	5.2	5.2	0	5.3	5.3	0.1		2523		
Xs227	3.6	4.3	0.7	3.7	4.4	0.8		2935		
Xs228	3.6	4.25	0.65	3.7	4.35	0.75		3192		
Xs229	1.75	3.3	1.55	1.85	3.4	1.65		3552		
Xs230	2.3	2.7	0.4	2.4	2.8	0.5		3861		
Xs231	3.3	4.9	1.6	3.4	5	1.7		4376		
Xs232	1.7	4.3	2.6	1.8	4.4	2.7		4685		
Xs233	1.8	4	2.2	1.9	4.1	2.3		4839		
Xs234	2.2	2.7	0.5	2.3	2.8	0.6		5045		
Xs235	3.6	3.89	0.29	3.7	3.99	0.39		5457		
Xs124	1.9	8.1	6.2	2	8.2	6.3		0	463	
Xs125	2.8	4.5	1.7	2.9	4.6	1.8		103		
Xs126	2.7	5.25	2.55	2.8	5.35	2.65		463		
Xs127	3.3	5.3	2	3.4	5.4	2.1	2402	206	824	1236
Xs128	3.4	11	7.6	3.5	11.1	7.7		360		
Xs129	3.8	5.7	1.9	3.9	5.8	2		566		
Xs130	2.9	6.1	3.2	3	6.2	3.3		824		
Xs131	2.75	4.1	1.35	2.85	4.2	1.45		1081		
Xs132	1.75	3.7	1.95	1.85	3.8	2.05		1390		
Xs133	2	3.4	1.4	2.1	3.5	1.5		2008		
Xs134	3.4	5.2	1.8	3.5	5.3	1.9		2163		
Xs135	2.1	4.4	2.3	2.2	4.5	2.4		2369		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs136	2.1	4.25	2.15	2.2	4.35	2.25	927	927	1442	1339
Xs137	3.2	6.2	3	3.3	6.3	3.1		669		
Xs298	2.3	4	1.7	2.36	4.06	1.76	618	515	1751	1700
Xs299	3.6	8.8	5.2	3.66	8.86	5.26		412		
Xs300	5.5	6	0.5	5.56	6.06	0.56		206		
Xs301	2.6	4.1	1.5	2.66	4.16	1.56		0		
Xs302	2.5	2.7	0.2	2.56	2.76	0.26				
Xs256	2.1	4.3	2.2	2.18	4.36	2.26	2369	257		
Xs257	1.8	6.4	4.6	1.88	6.46	4.66		463		
Xs258	1.6	5.1	3.5	1.68	5.16	3.56		617		
Xs259	1.5	3.7	2.2	1.58	3.76	2.26		823		
Xs260	1.5	4.7	3.2	1.58	4.76	3.26		1029		
Xs261	1.4	5.6	4.2	1.48	5.66	4.26		1286		
Xs262	1.5	2.5	1	1.58	2.56	1.06		1337		
Xs263	1.8	5.6	3.8	1.88	5.66	3.86		1543		
Xs264	1.9	5	3.1	1.98	5.06	3.16		1749		
Xs265	1.1	4.9	3.8	1.18	4.96	3.86		2212		
Xs266	1.8	5.1	3.3	1.88	5.16	3.36		2369		
Xs267	3.5	14	10.5	3.58	14.06	10.56	6334	257		
Xs268	2.2	5.1	2.9	2.28	5.16	2.96		2213		
Xs269	3.1	7.9	4.8	3.18	7.96	4.86		1801		
Xs270	3.9	9.2	5.3	3.98	9.26	5.36		1286		
Xs271	4.1	15	10.9	4.18	15.06	10.96		823		
Xs272	2.3	4.8	2.5	2.38	4.86	2.56		2316		
Xs273	2	4.2	2.2	2.08	4.26	2.26		2676		
Xs274	2.4	2.4	0	2.48	2.46	0.06		3345		
Xs275	2.7	7.7	5	2.78	7.76	5.06		4015		
Xs276	2.9	5.1	2.2	2.98	5.16	2.26		4633		
Xs277	2.8	6.3	3.5	2.88	6.36	3.56		5148		
Xs278	2.2	5.5	3.3	2.28	5.56	3.36		5663		
Xs279	2.3	6.1	3.8	2.38	6.16	3.86		5920		
Xs280	3.2	7.1	3.9	3.28	7.16	3.96		6229		
Xs281	2.4	6.7	4.3	2.48	6.76	4.36	721	309		
Xs282	1.2	6.5	5.3	1.28	6.56	5.36		669		
Xs283	2.1	6.9	4.8	2.18	6.96	4.86		926		
Xs284	2.9	9.5	6.6	2.98	9.56	6.68	1802	360		
036										
Xs285	3	6.5	3.5	3.06	6.56	3.56		669		
Xs286	3.7	5.4	1.7	3.76	5.46	1.76		1029		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs287	2.7	5.3	2.6	2.76	5.36	2.66		1441		
Xs288	2.6	6.2	3.6	2.66	6.26	3.66		1647		
Xs289	2.4	5.3	2.9	2.46	5.36	2.96		1853		
Xs290	1.1	5	3.9	1.16	5.06	3.96		2162		
Xs291	1.1	9	7.9	1.16	9.06	7.96	1801	309		
Xs292	2.2	5.3	3.1	2.26	5.36	3.16		824		
Xs293	2.1	9.4	7.3	2.16	9.46	7.36		1030		
Xs294	1.5	8.3	6.8	1.56	8.36	6.86		1236		
Xs295	0.9	5.3	4.4	0.96	5.36	4.46		1493		
Xs296	2.1	6.2	4.1	2.16	6.26	4.16		1647		
Xs297	2.2	6.1	3.9	2.26	6.16	3.96		1801		
Xs303	3.5	4.9	1.4	3.56	4.96	1.46	412	360		
Xs304	2.8	6.8	4	2.86	6.86	4.06		257		
Xs305	2.2	3.5	1.3	2.26	3.56	1.36	360	51		
Xs306	2.8	6.1	3.3	2.86	6.16	3.36	257	103		
Xs307	3.1	6.1	3	3.16	6.16	3.06	2266	103		
Xs308	3.3	5.3	2	3.36	5.36	2.06		412		
Xs309	2.6	6.3	3.7	2.66	6.36	3.76	927	103		
Xs310	3	7	4	3.06	7.06	4.06		257		
Xs311	3	5.4	2.4	3.06	5.46	2.46		412		
Xs312	3.2	5.1	1.9	3.26	5.16	1.96		618		
Xs313	2.8	6.2	3.4	2.86	6.26	3.46		824		
Xs314	3.2	6.6	3.4	3.26	6.66	3.46		1493		
Xs315	3.6	6.5	2.9	3.66	6.56	2.96		2265		
Xs316	2.9	5.1	2.2	2.96	5.16	2.26	618	103	1493	1648
Xs317	5.2	5.2	0	5.26	5.26	0.06		257		
Xs318	5.2	6.6	1.4	5.26	6.66	1.46		412		
Xs319	2.2	2.2	0	2.26	2.26	0.06		566		
Xs320	4.7	4.9	0.2	4.76	4.96	0.26	412	360	1082	1339
Xs321	4.9	4.9	0	4.96	4.96	0.06		257		
Xs322	5.5	8.1	2.6	5.56	8.16	2.66		154		
Xs323	6.3	8.2	1.9	6.36	8.26	1.96		0		
Xs324	2.7	4.2	1.5	2.76	4.26	1.56	1699	0		
Xs325	4.2	6	1.8	4.26	6.06	1.86		257		
Xs326	5.2	6.2	1	5.26	6.26	1.06		463		
Xs327	5.3	6.3	1	5.36	6.36	1.06		669		
Xs328	5.1	6.6	1.5	5.16	6.66	1.56		978		
Xs329	5.6	6.2	0.6	5.66	6.26	0.66		1287		
Xs330	5.4	8.4	3	5.46	8.46	3.06		1596		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs236	1.1	5.1	4	1.18	5.18	4.08				
Xs237	1.6	4.1	2.5	1.68	4.18	2.58				
Xs238	2.1	4.8	2.7	2.18	4.88	2.78		103		
Xs239	1.5	4.8	3.3	1.58	4.88	3.38		51		
035				0.08	0.08	0.08				
Xs240	1.8	4.9	3.1	1.88	4.98	3.18	206	103		
Xs241	2.4	6.5	4.1	2.48	6.58	4.18	721	51		
Xs242	2.2	7	4.8	2.28	7.08	4.88		412		
Xs243	2.2	5.3	3.1	2.28	5.38	3.18		566		
Xs244	1.8	5.1	3.3	1.88	5.18	3.38	618	566		
Xs245	2.2	6	3.8	2.28	6.08	3.88		412		
Xs246	1.1	5.4	4.3	1.18	5.48	4.38	566	257		
Xs247	2	6	4	2.08	6.08	4.08	566	103		
Xs248	2.4	5.8	3.4	2.48	5.88	3.48		463		
Xs249	1.2	5.1	3.9	1.28	5.18	3.98		515		
Xs250	2.6	5.1	2.5	2.68	5.18	2.58	699	618		
Xs251	2.4	5.1	2.7	2.48	5.18	2.78	721	669		
Xs252	2.4	5.4	3	2.48	5.48	3.08		618		
Xs253	2.4	5.8	3.4	2.48	5.88	3.48		360		
Xs254	2.4	5.7	3.3	2.48	5.78	3.38		154		
Xs255	2	4.7	2.7	2.08	4.78	2.78		103		
Xs348	2.4	5	2.6	2.34	4.94	2.54	412	412	721	875
Xs349	3.5	5.8	2.3	3.44	5.74	2.24		257		
Xs350	3.4	5.8	2.4	3.34	5.74	2.34		154		
Xs351	2.1	2.8	0.7	2.04	2.74	0.64		0		
Xs352	3	3.7	0.7	2.94	3.64	0.64	412	360	566	824
Xs353	3.1	5	1.9	3.04	4.94	1.84		257		
Xs354	3.4	6.3	2.9	3.34	6.24	2.84		154		
Xs355	3.2	4.2	1	3.14	4.14	0.94		51		
Xs356	3.4	4.7	1.3	3.34	4.64	1.24				
Xs357	3.7	5.4	1.7	3.64	5.34	1.64				
Xs358	1.7	4.2	2.5	1.64	4.14	2.44	257	51		
Xs359	3.2	5.2	2	3.14	5.14	1.94		154		
Xs360	2.1	4.5	2.4	2.04	4.44	2.34		257		
Xs361	2.9	4.4	1.5	2.84	4.34	1.44				
Xs331	3.2	6.5	3.3	3.14	6.44	3.24	618	566	1287	1030
Xs332	3.5	10.8	7.3	3.44	10.74	7.24		515		
Xs333	4.2	8.4	4.2	4.14	8.34	4.14		360		
Xs334	4.8	4.8	0	4.74	4.74	-0.06		206		

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs335	3.3	3.6	0.3	3.24	3.54	0.24		51		
Xs336	2.8	6.4	3.6	2.74	6.34	3.54	618	515	772	1133
Xs337	2.6	6.1	3.5	2.54	6.04	3.44		412		
Xs338	3.8	8.8	5	3.74	8.74	4.94		206		
Xs339	5.3	8.3	3	5.24	8.24	2.94		51		
Xs340	2	4.7	2.7	1.94	4.64	2.64	515	412		
Xs341	2.9	4.8	1.9	2.84	4.74	1.84		309		
Xs342	6.3	8.1	1.8	6.24	8.04	1.74		206		
Xs343	3.9	3.9	0	3.84	3.84	-0.06		51		
Xs344	3.3	7.7	4.4	3.24	7.64	4.34	257	51	824	1648
Xs345	3.6	8	4.4	3.54	7.94	4.34		103		
Xs346	7.8	7.8	0	7.74	7.74	-0.06		154		
Xs347	6.5	6.5	0	6.44	6.44	-0.06		257		
022										
023	1.2	3.6	2.4							
024	1.3	5.7	4.4							
025	4.5	4.5	0							
026	4.2	7	2.8				206	0	309	
027	6	8.6	2.6					51		
028	7.3	8.1	0.8					103		
029	5.2	5.3	0.1					154		
030	5.2	5.3	0.1					206		
031										
032										
017										
018										
019										
020										
021										
Xs362	2.3	6.9	4.6	2.24	6.84	4.54	1162	318		
Xs363	2.3	6.8	4.5	2.24	6.74	4.5		562		
Xs364	2.2	5.2	3	2.14	5.14	3		712		
Xs365	2	6.6	4.6	1.94	6.54	4.6		862		
Xs366	1.7	5.6	3.9	1.64	5.54	3.84		356		
Xs367	1.9	7.4	5.5	1.84	7.34	5.44		262		
Xs368	1.8	4.5	2.7	1.74	4.44	2.64	525	206		
Xs371	3.1	5.7	2.6	3.04	5.64	2.54				
Xs372	3.8	14.6	10.8	3.74	14.54	10.74				
Xs373	4	14	10	3.94	13.94	9.94				

Exhibit B (continued)

IDENT	Water (feet)	Total (feet)	Sediment (feet)	Water Corr (feet)[a]	Total Corr (feet)[a]	Sediment Corr (feet)[a]	Total Width (feet)	Distance from bank (feet)	Length (feet)	Segment Midpoint (feet)
Xs374	3	9	6	2.94	8.94	5.94				
Xs375	2.8	7.9	5.1	2.74	7.84	5.04				
Xs376	3.5	11.6	8.1	3.44	11.54	8.04				
Xs377	3.3	9	5.7	3.24	8.94	5.64				
Xs378	2.8	11.6	8.8	2.74	11.54	8.74				
Xs379	2	6	4	1.94	5.94	3.94				
Xs382	2.8	6.6	3.8	2.74	6.54	3.74				
Xs380	2.6	5.9	3.3	2.54	5.84	3.24				
Xs381	3	6.6	3.6	2.94	6.54	3.54				
Xs383	2.6	6.3	3.7	2.54	6.24	3.64				
Xs384	2.8	9	6.2	2.74	8.94	6.14				
Xs385	2.75	8.6	5.85	2.69	8.54	5.79				

[a]*During the course of the survey, water surface levels in the Impoundment varied slightly, but the average water surface elevation was 1.50 feet local datum. All soundings were standardized to an average water surface elevation of 1.50 local datum. Local gauge readings were obtained twice daily by Racine County staff, once in the early morning at about 07:30 hours and once in the afternoon at about 15:00 hours, The 07:30 water level gauge reading was used to adjust depths recorded by SEWRPC staff during the morning hours, while the 15:00 water level gauge reading was used to adjust depths recorded during the afternoon hours.*

Source: SEWRPC.

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SEWRPC Staff Memorandum

FEASIBILITY ASSESSMENT OF DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

Exhibit C

CROSS-SECTIONS AND PROPOSED NAVIGATIONAL CHANNEL DESIGNS

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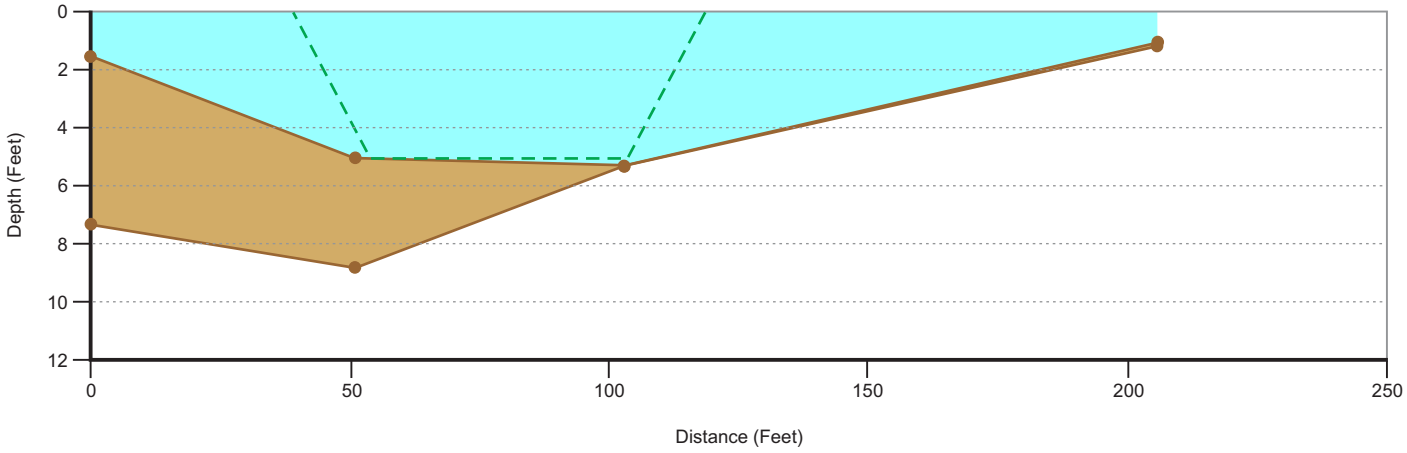
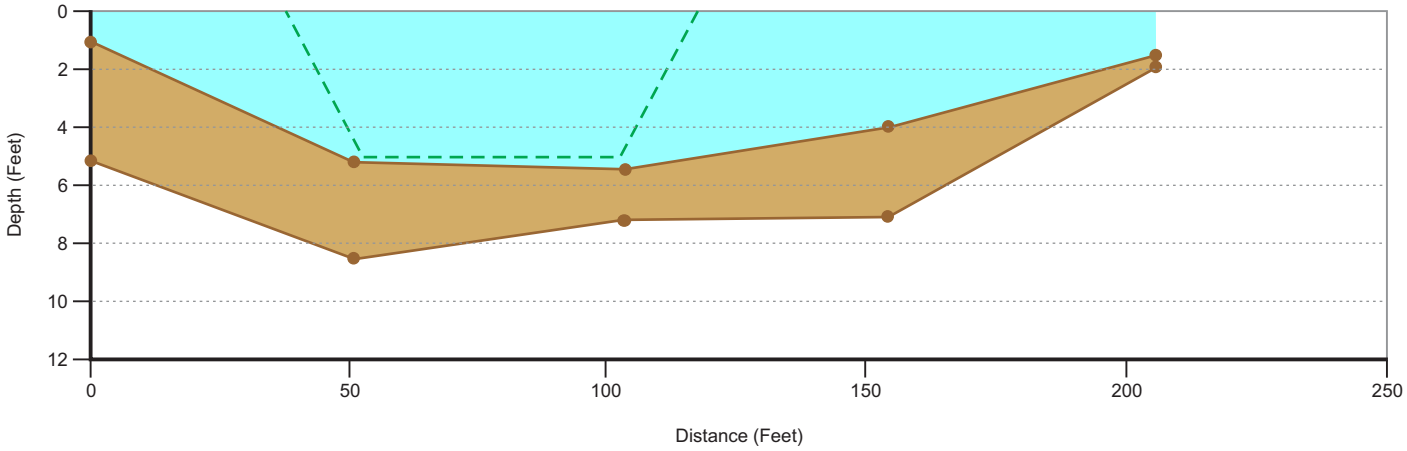
Exhibit C

CROSS-SECTIONS AND PROPOSED NAVIGATIONAL CHANNEL DESIGNS

CROSS-SECTION 1 SAMPLE POINTS 6-9



CROSS-SECTION 2 SAMPLE POINTS 11-15



CROSS-SECTION 3 SAMPLE POINTS 19-22

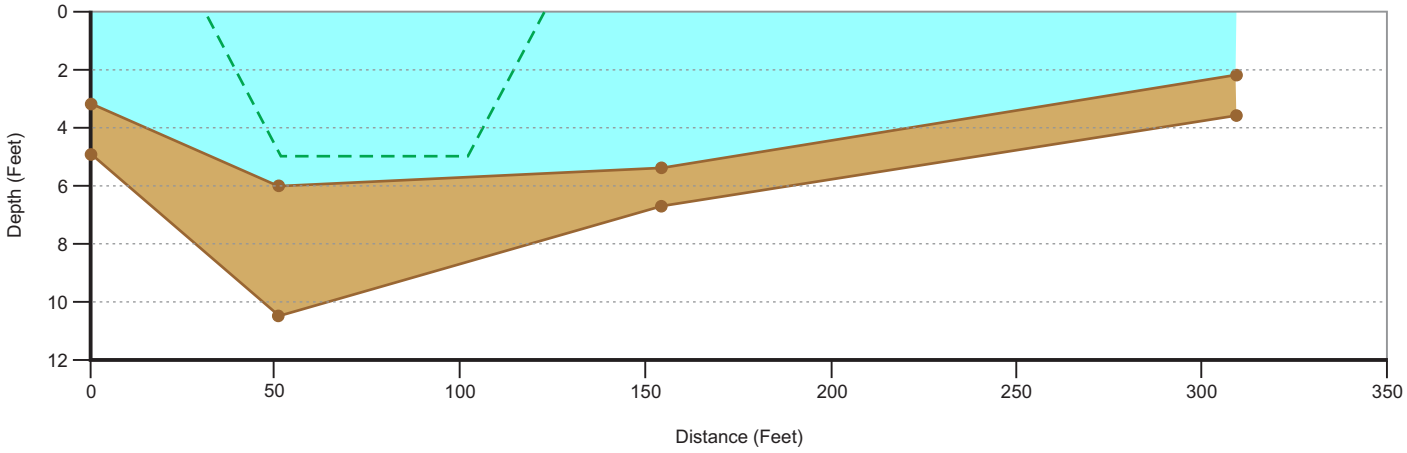
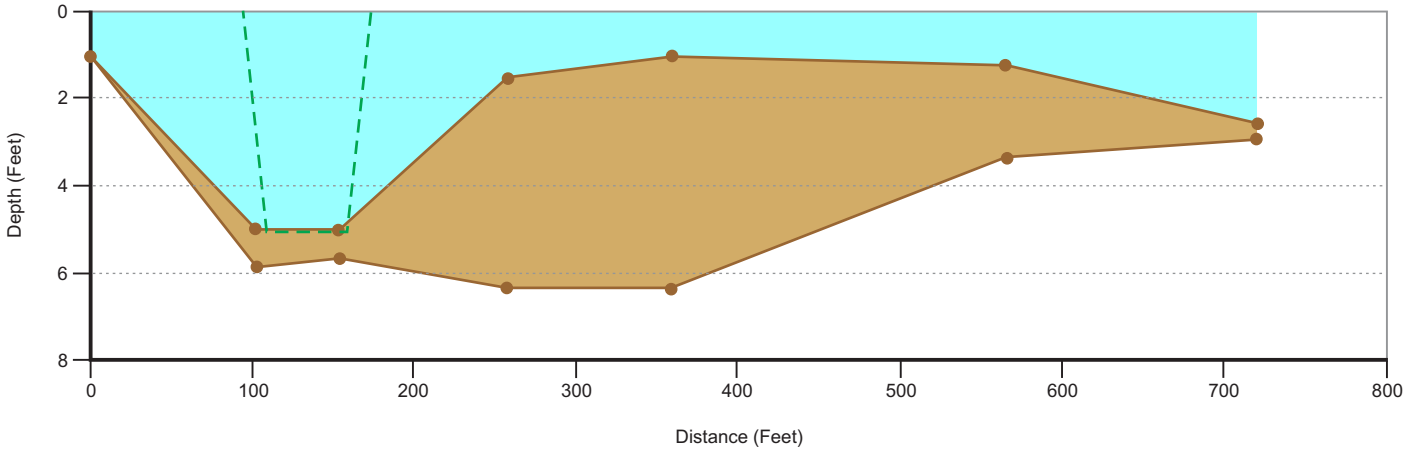
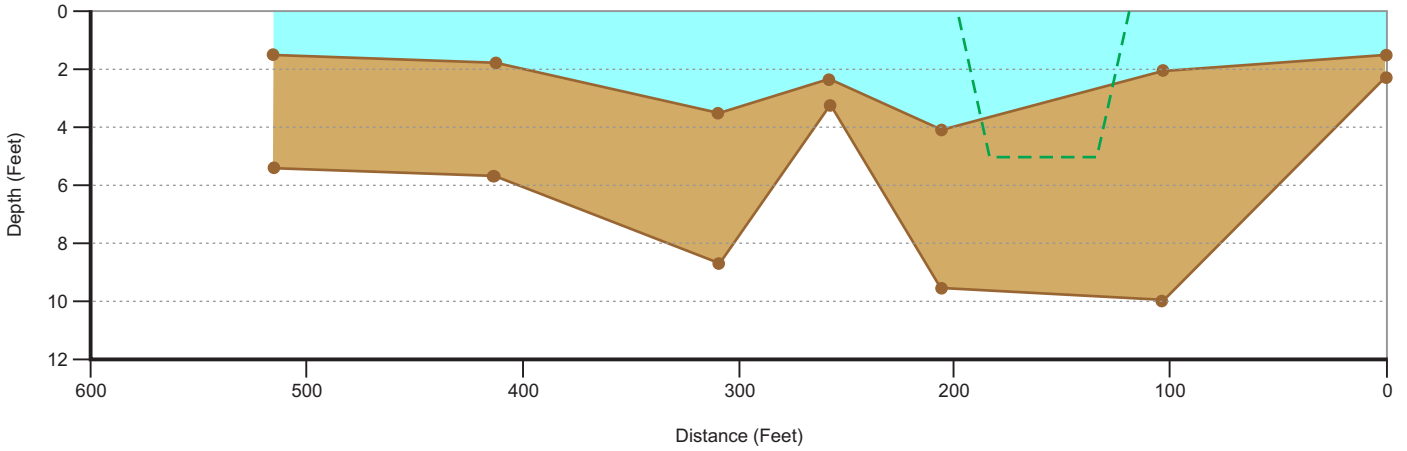


Exhibit C (continued)

CROSS-SECTION 4 SAMPLE POINTS 23-29



CROSS-SECTION 5 SAMPLE POINTS 45-51



CROSS-SECTION 6 SAMPLE POINTS 52-55

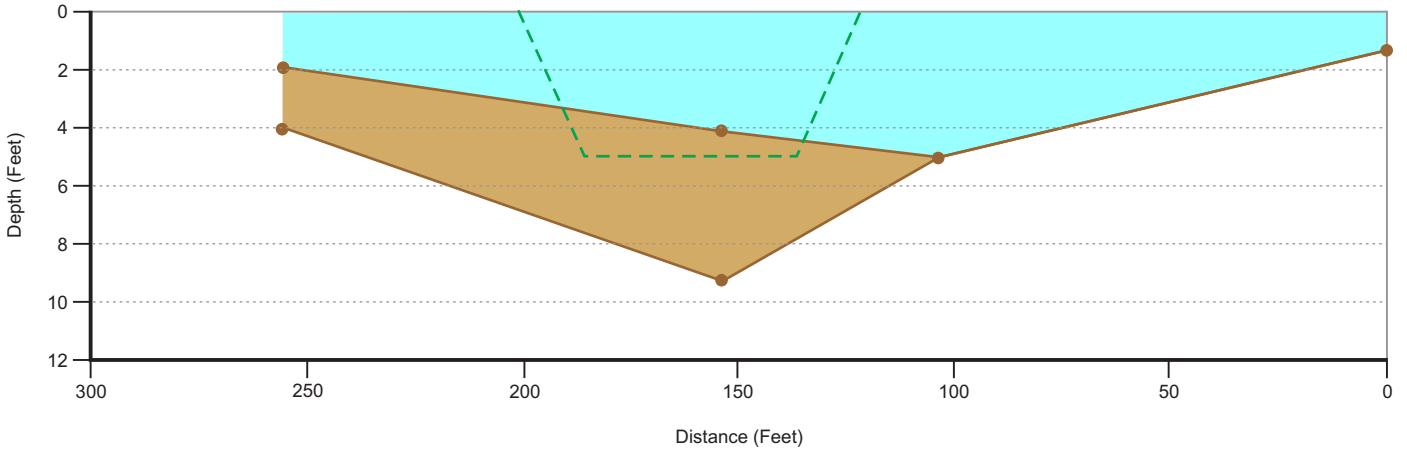
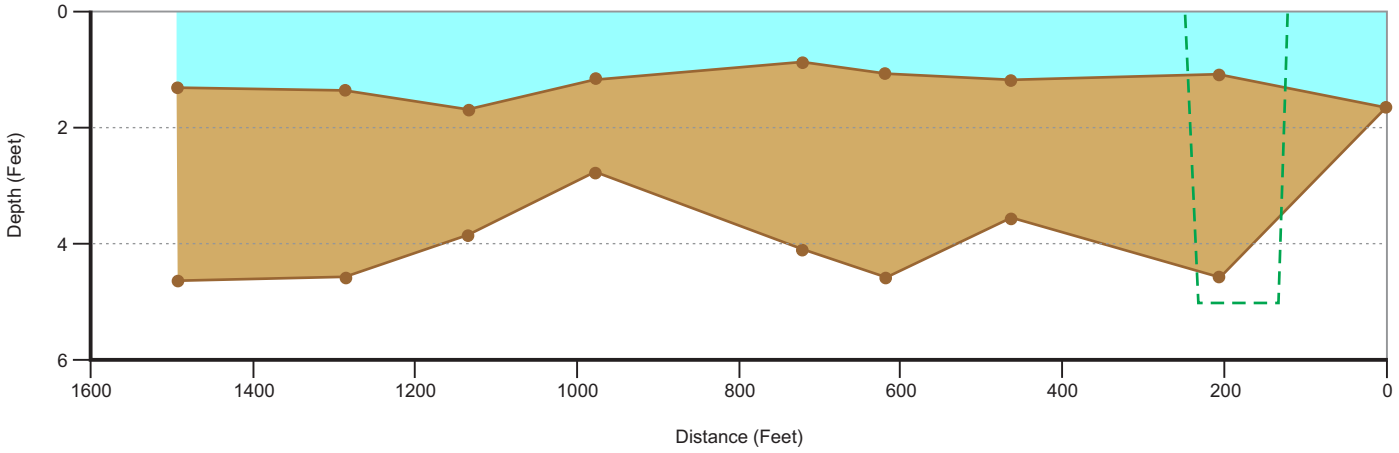
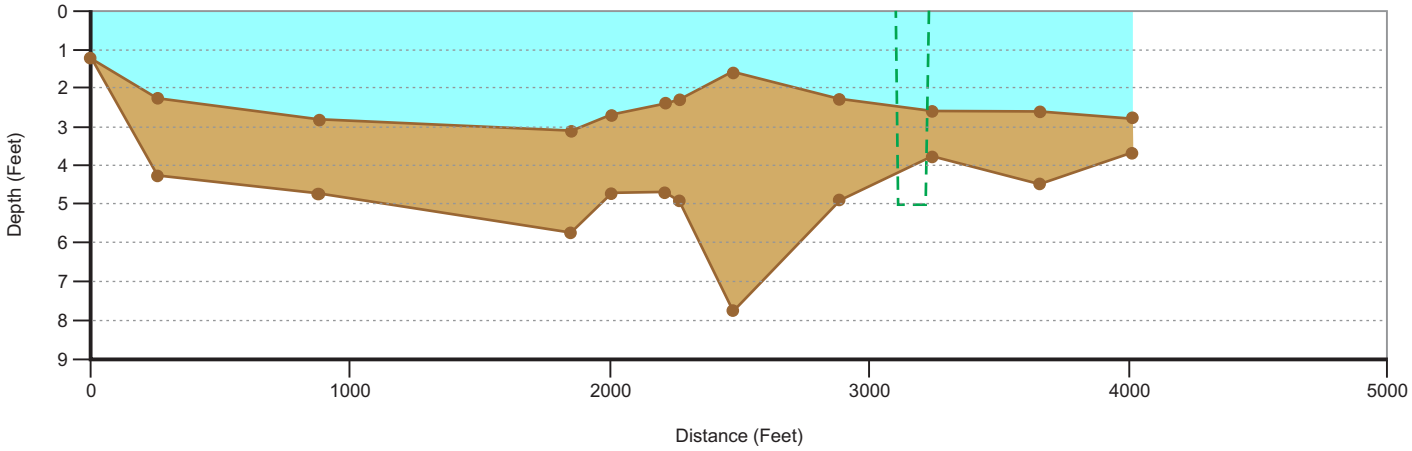


Exhibit C (continued)

CROSS-SECTION 7 SAMPLE POINTS 33-42



CROSS-SECTION 8 SAMPLE POINTS 56-66



CROSS-SECTION 9 SAMPLE POINTS 67-83

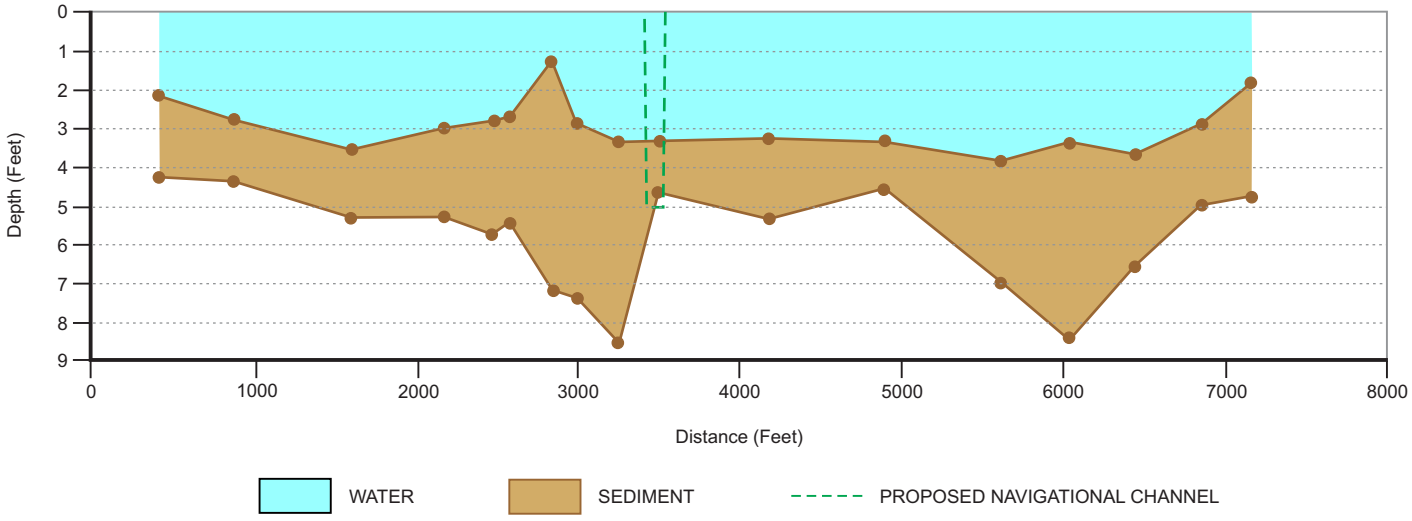
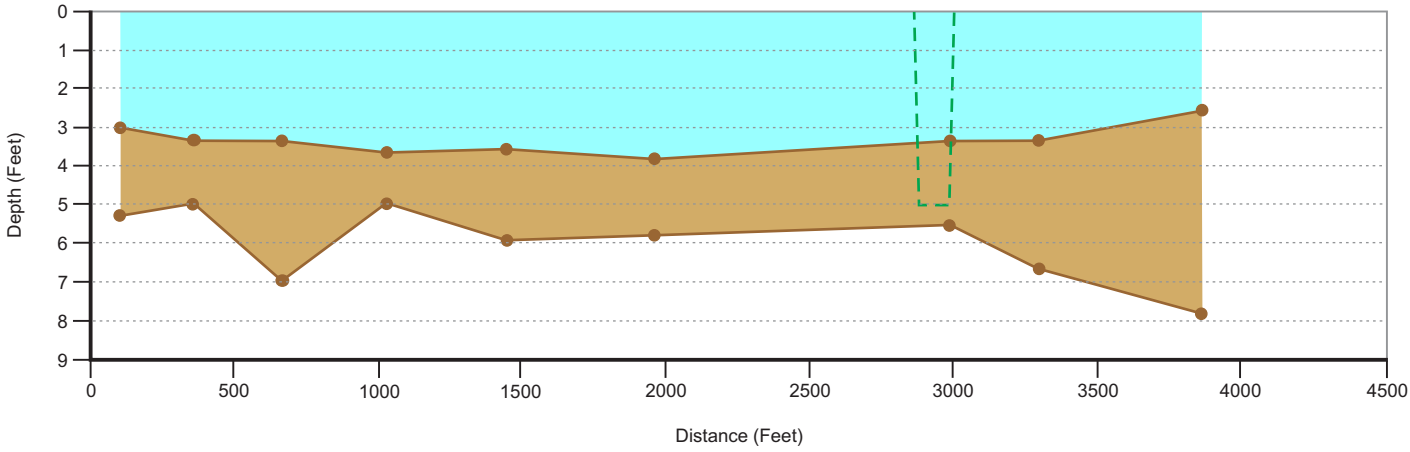
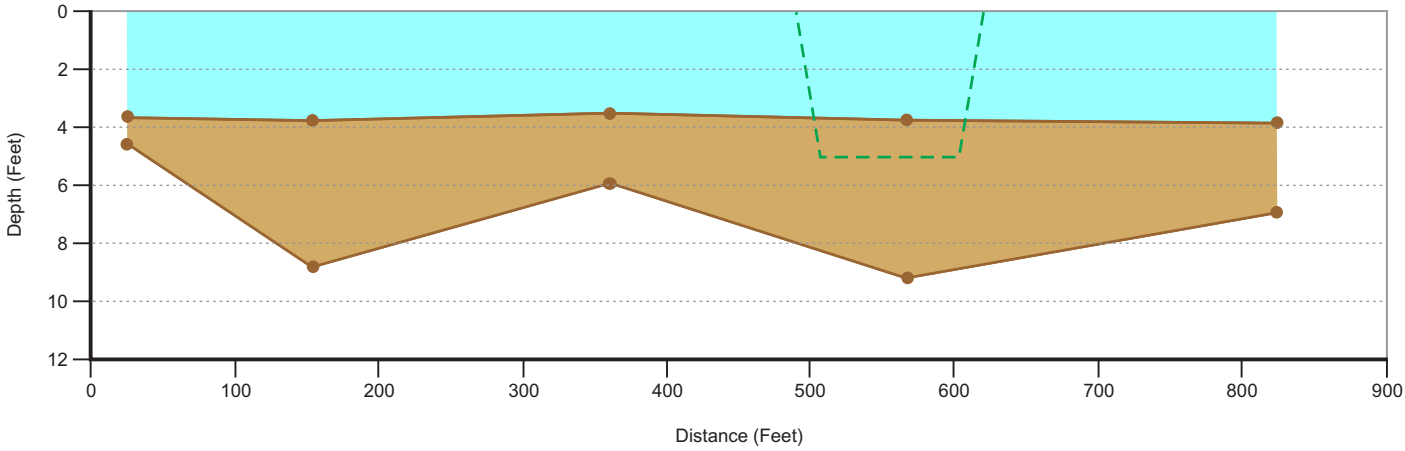


Exhibit C (continued)

CROSS-SECTION 10 SAMPLE POINTS 84-92



CROSS-SECTION 11 SAMPLE POINTS 93-97



CROSS-SECTION 12 SAMPLE POINTS 98-102

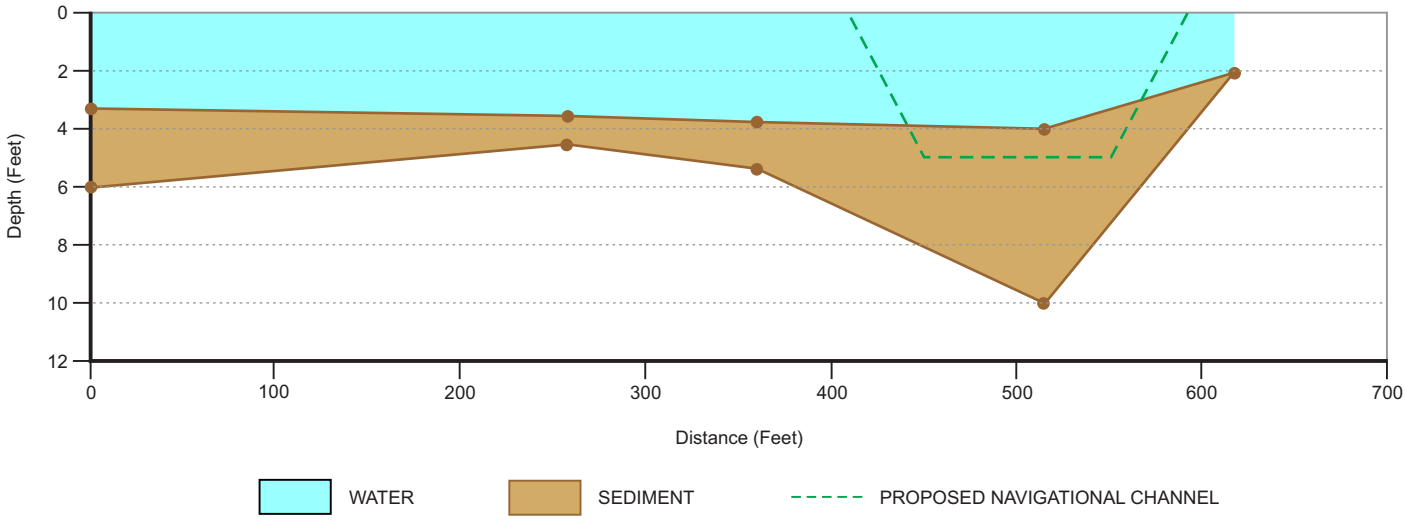
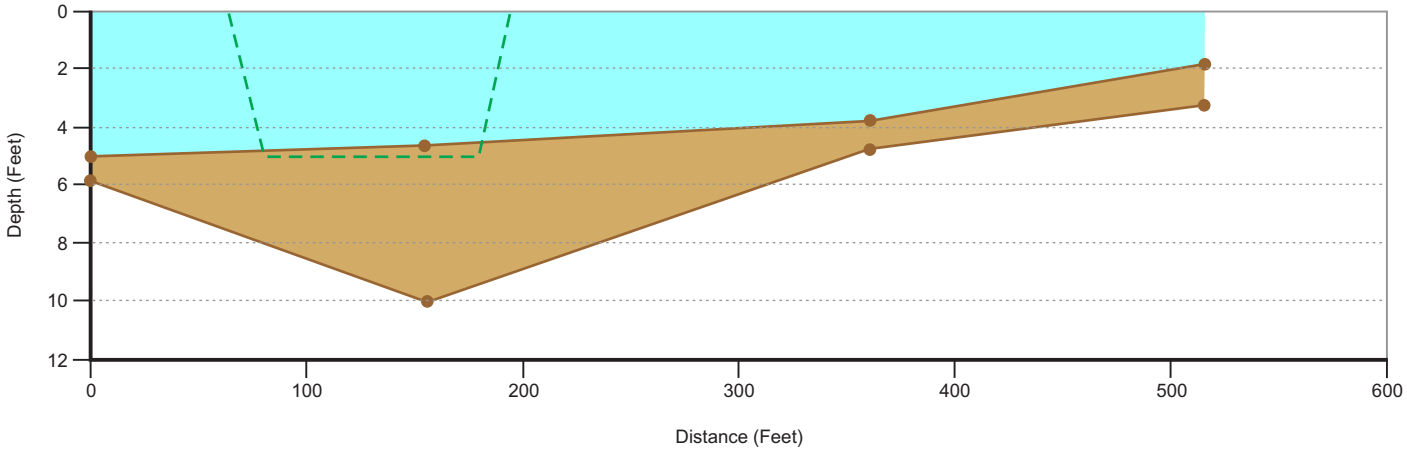
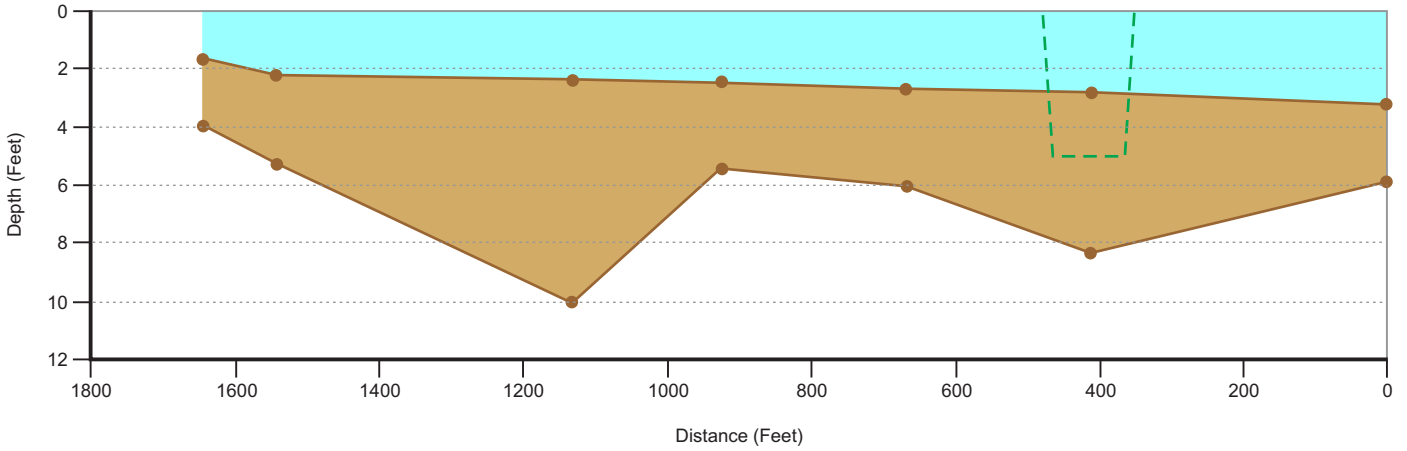


Exhibit C (continued)

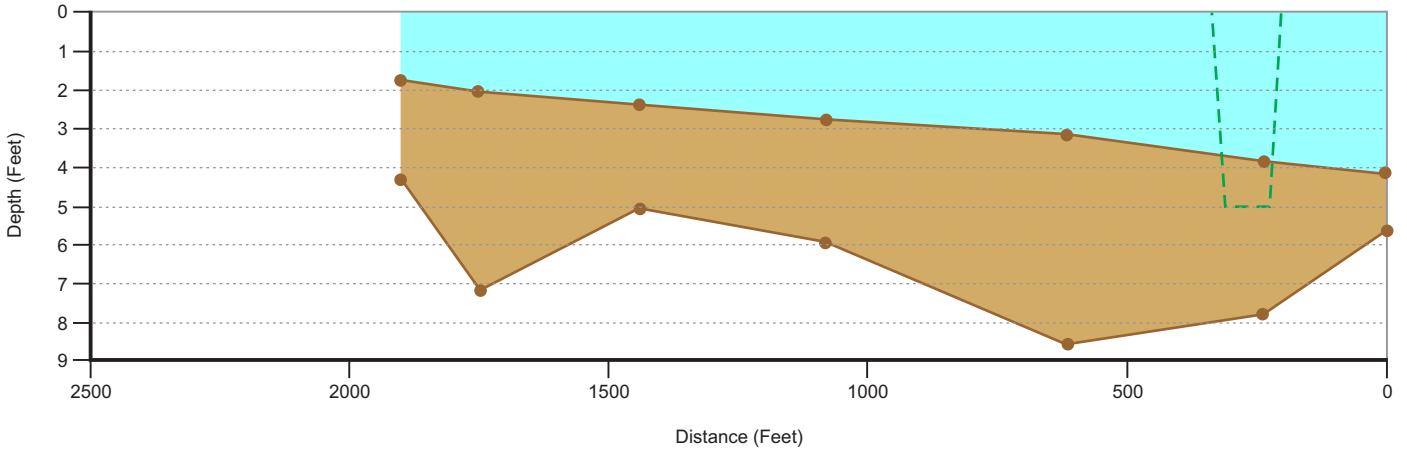
CROSS-SECTION 13 SAMPLE POINTS 103-106



CROSS-SECTION 14 SAMPLE POINTS 107-113



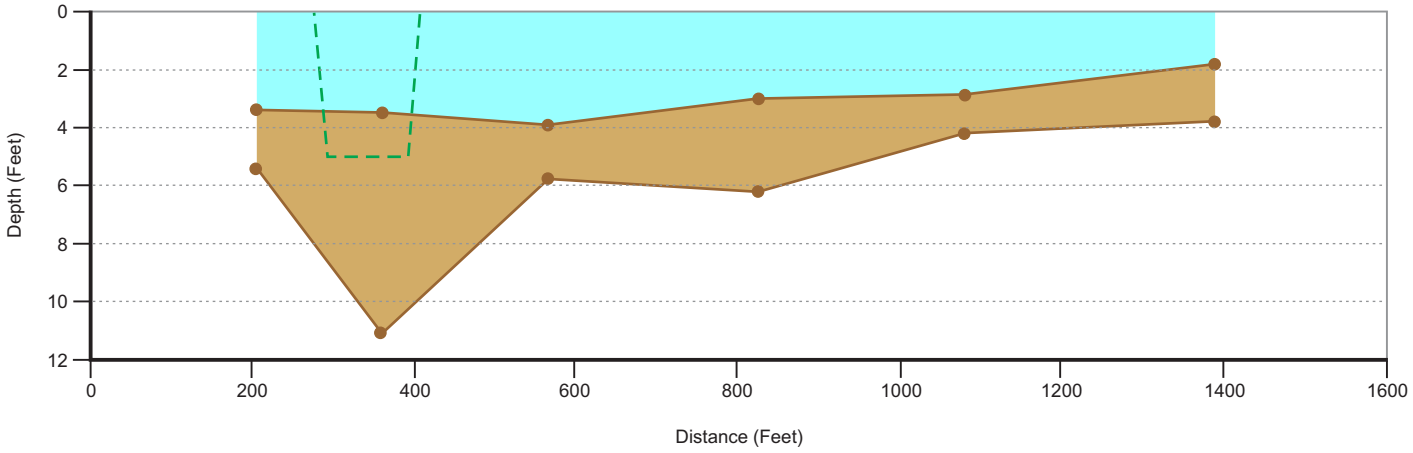
CROSS-SECTION 15 SAMPLE POINTS 114-120



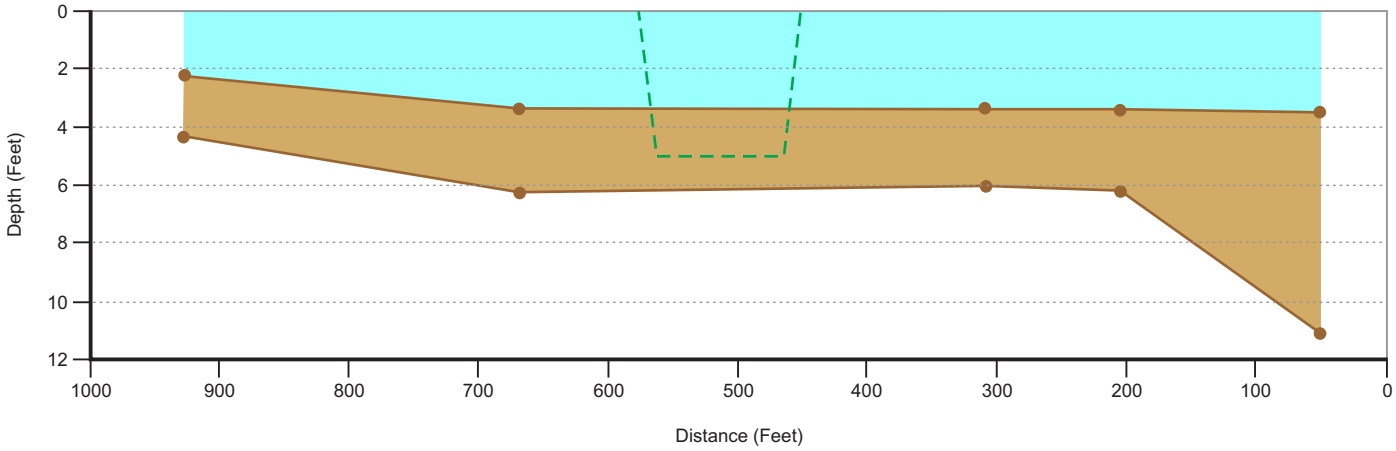
WATER SEDIMENT PROPOSED NAVIGATIONAL CHANNEL

Exhibit C (continued)

CROSS-SECTION 16 SAMPLE POINTS 127-132



CROSS-SECTION 17 SAMPLE POINTS 136-140



CROSS-SECTION 18 SAMPLE POINTS 144-148

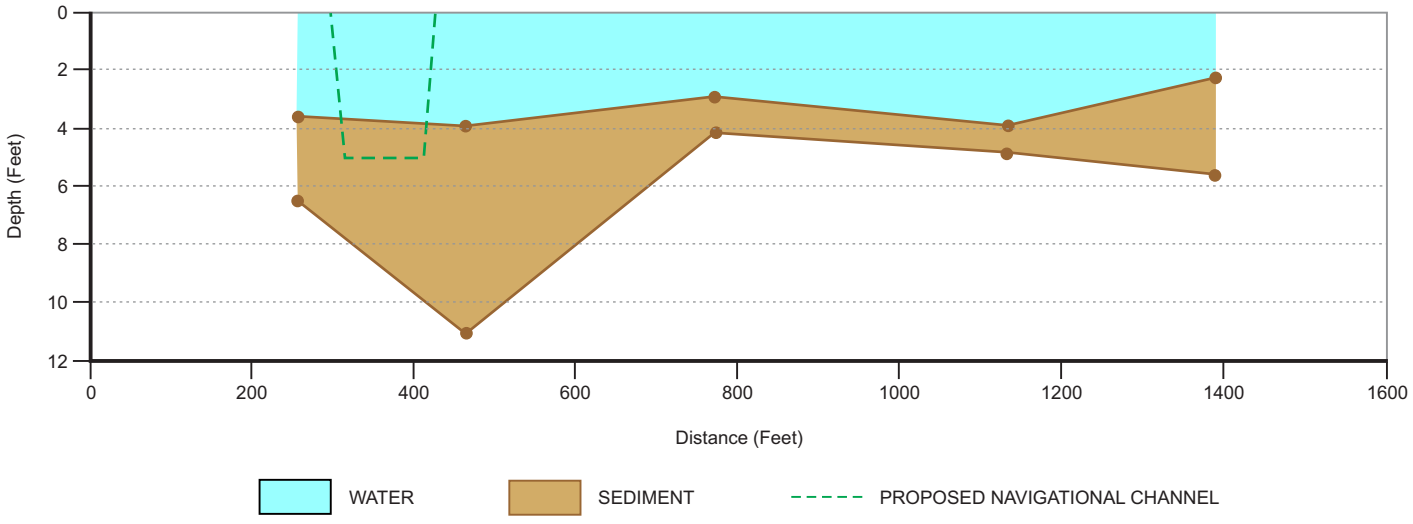
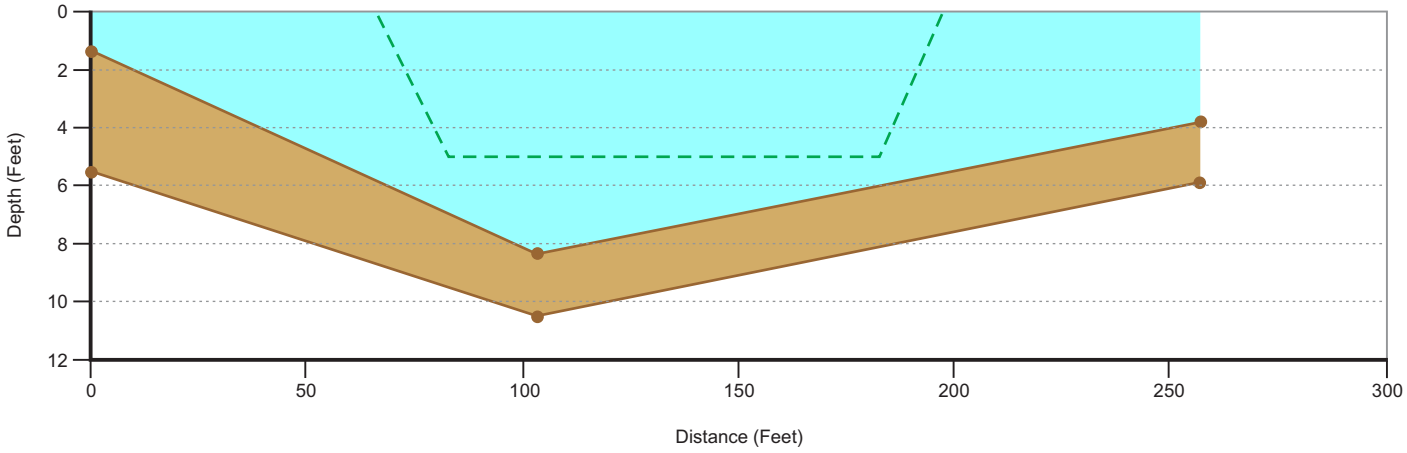
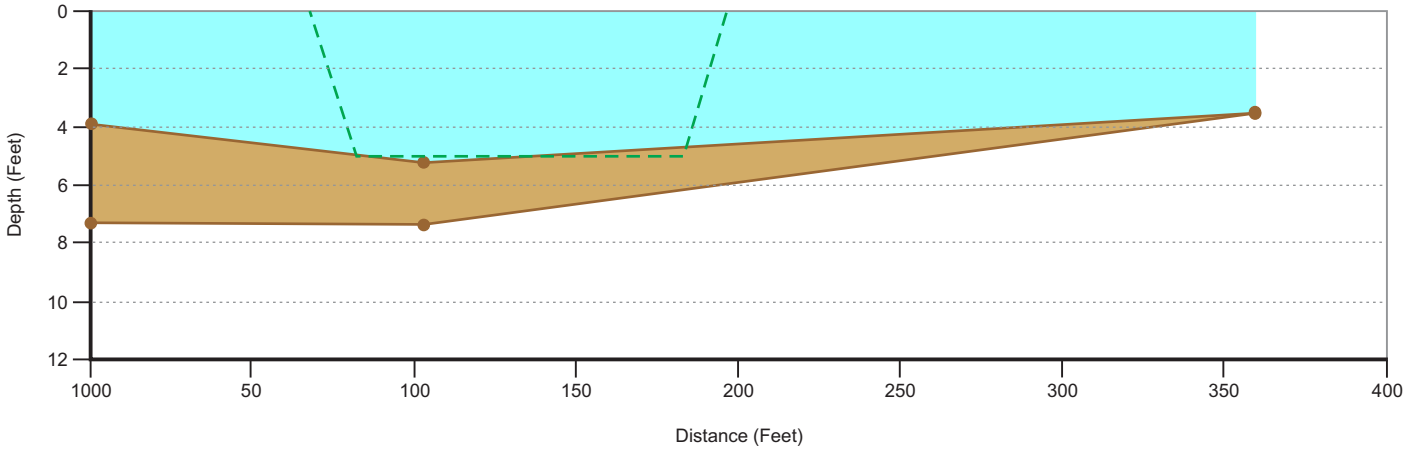


Exhibit C (continued)

CROSS-SECTION 19 SAMPLE POINTS 149-151



CROSS-SECTION 20 SAMPLE POINTS 157-159



CROSS-SECTION 21 SAMPLE POINTS 163-166

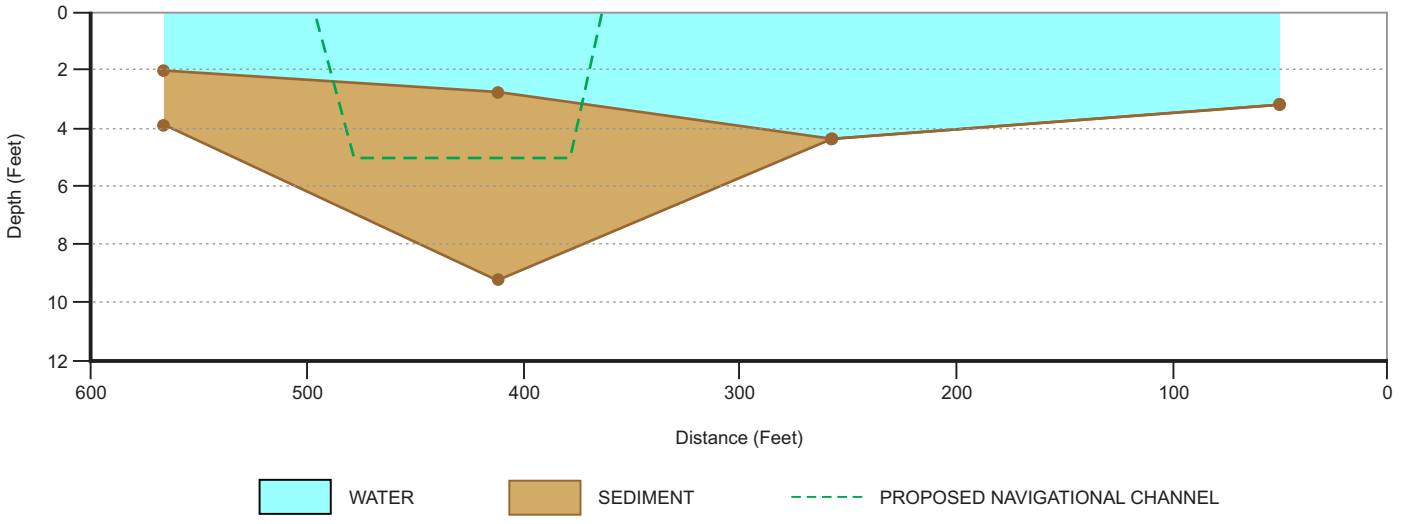
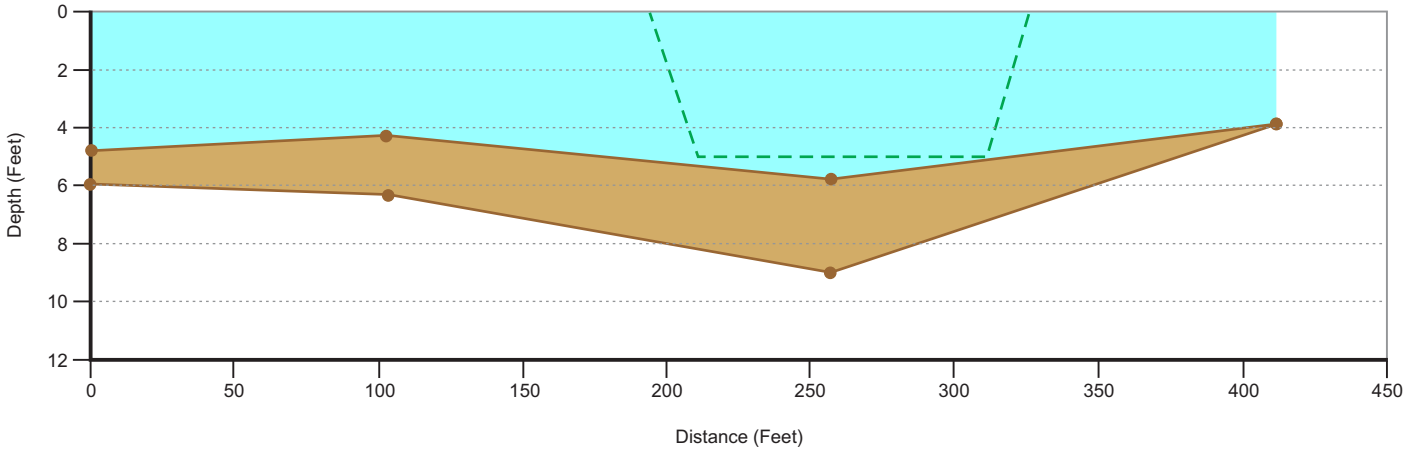
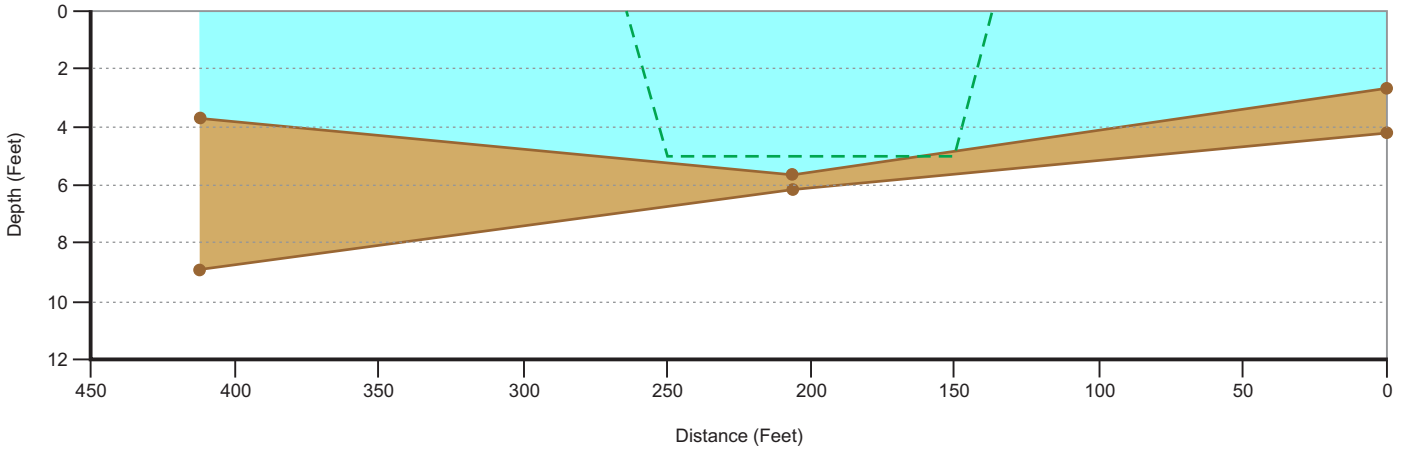


Exhibit C (continued)

CROSS-SECTION 22 SAMPLE POINTS 173-176



CROSS-SECTION 23 SAMPLE POINTS 299-301



CROSS-SECTION 24 SAMPLE POINTS 316-319

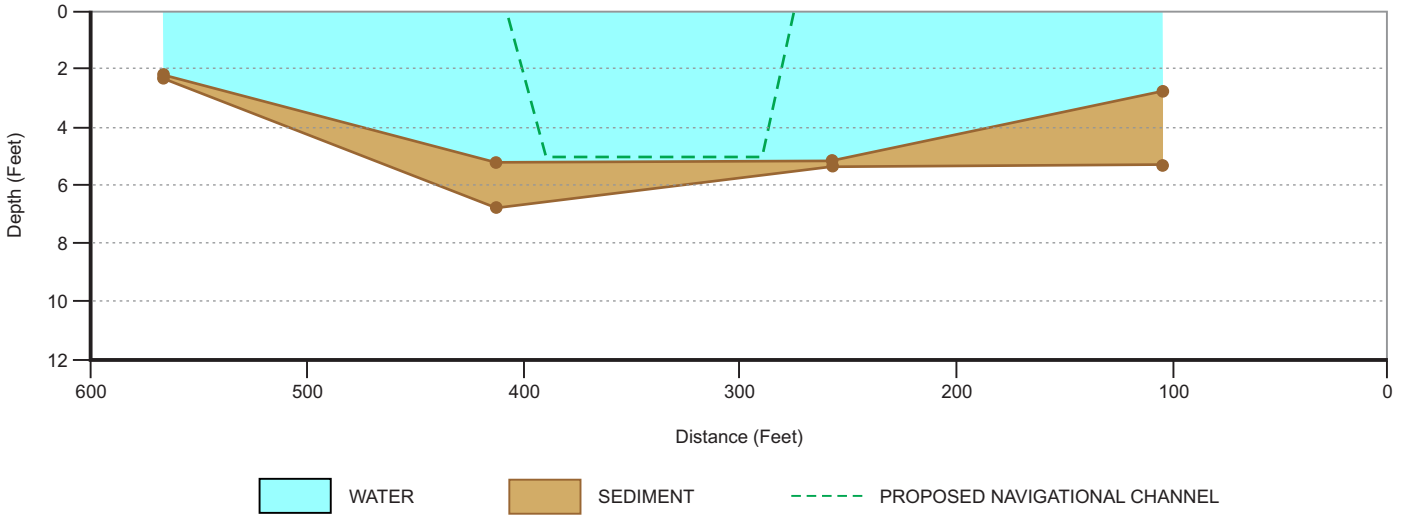
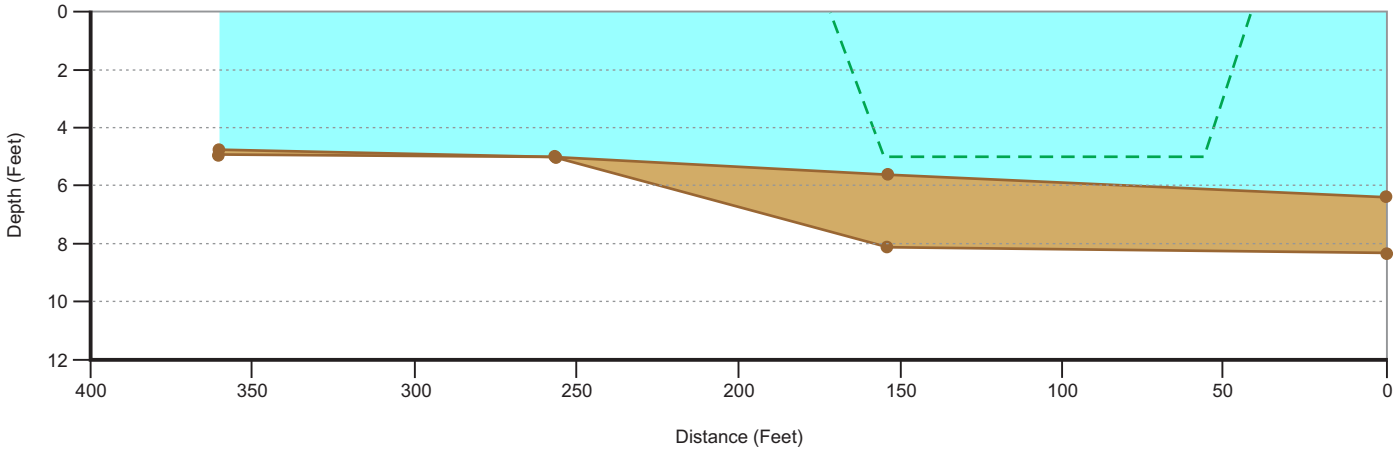
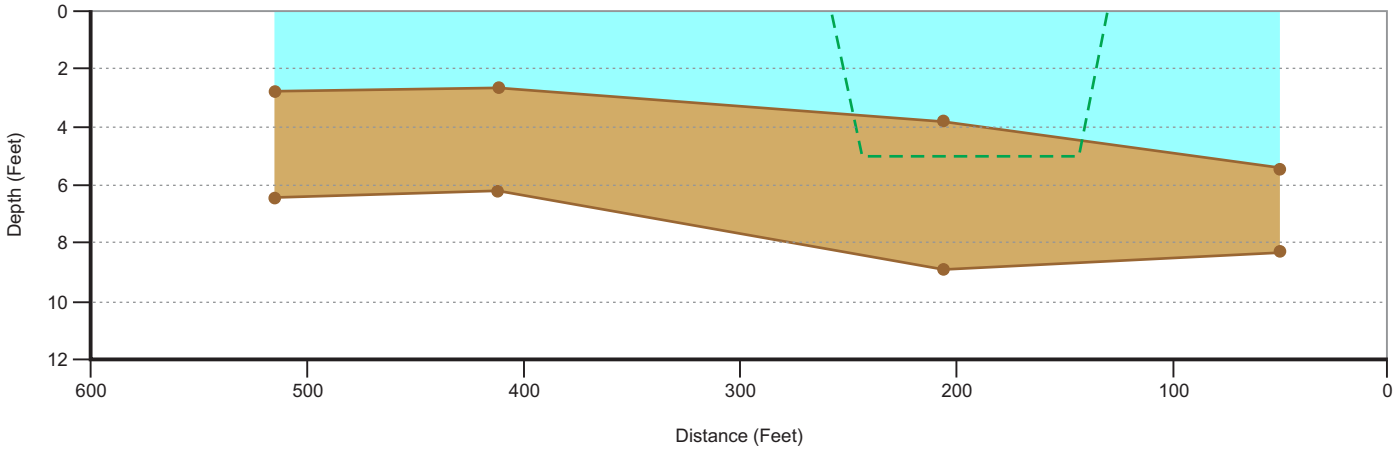


Exhibit C (continued)

CROSS-SECTION 25 SAMPLE POINTS 320-323



CROSS-SECTION 26 SAMPLE POINTS 336-339



CROSS-SECTION 27 SAMPLE POINTS 340-343

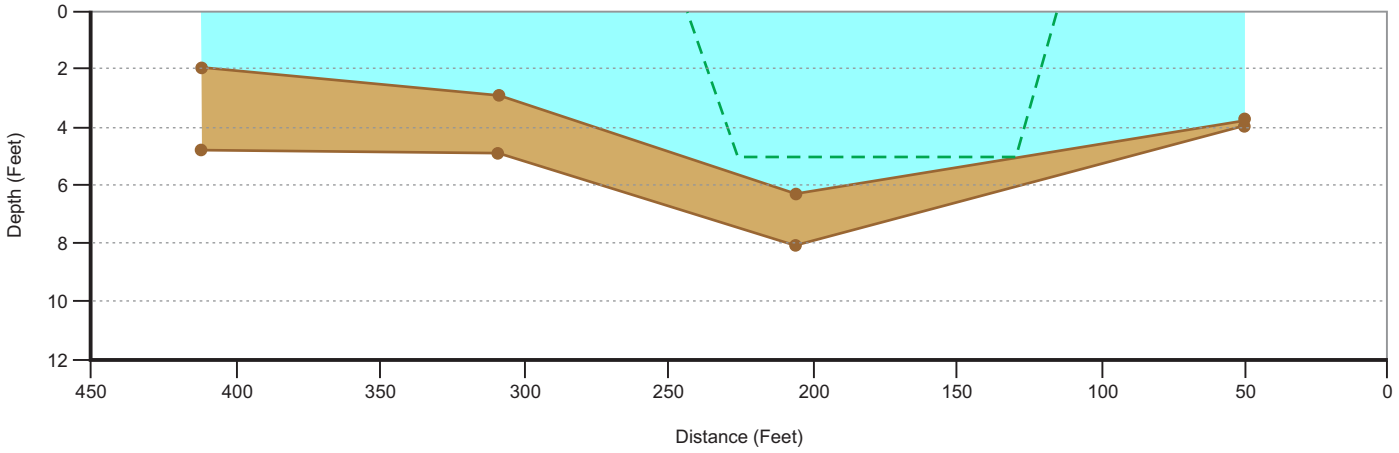
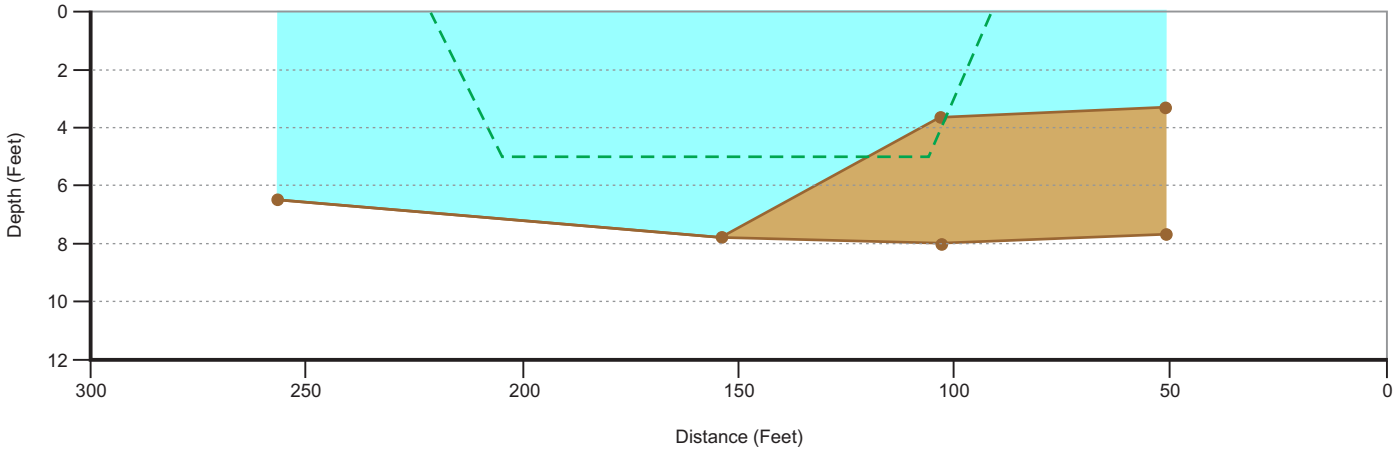
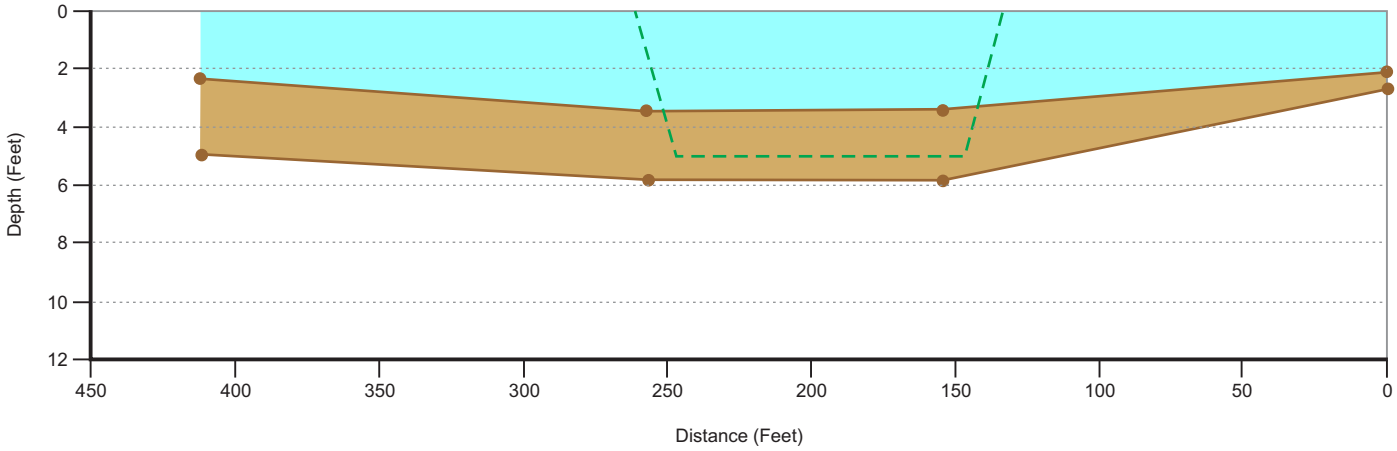


Exhibit C (continued)

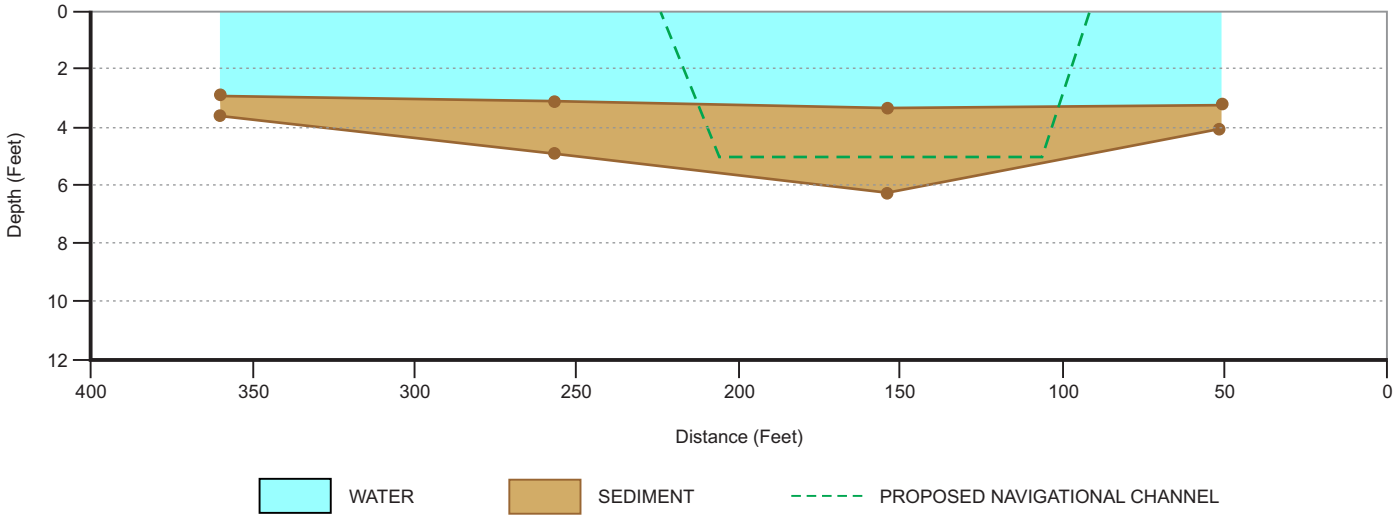
CROSS-SECTION 28 SAMPLE POINTS 344-347



CROSS-SECTION 29 SAMPLE POINTS 348-351



CROSS-SECTION 30 SAMPLE POINTS 352-355



SEWRPC Staff Memorandum

FEASIBILITY ASSESSMENT OF DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

Exhibit D

PRELIMINARY ENVIRONMENTAL ASSESSMENT

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Exhibit D

ENVIRONMENTAL ANALYSIS AND DECISION ON THE NEED FOR AN ENVIRONMENTAL IMPACT STATEMENT (EIS)

Form 1600-1 Rev. 6-2001
00200146.DOC
300-1095
12/06/11

Department of Natural Resources (DNR)

Region or Bureau
South East Region
Type List Designation
Type List Designation II

NOTE TO REVIEWERS: This document is a DNR environmental analysis that evaluates probable environmental effects and decides on the need for an EIS. The attached analysis includes a description of the proposal and the affected environment. The DNR has reviewed the Attachments and, upon certification, accepts responsibility for their scope and content to fulfill requirements in s. NR 150.22, Wis. Adm. Code. Your comments should address completeness, accuracy or the EIS decision. For your comments to be considered, they must be received by the contact person before 4:30 p.m., Insert Date.

Contact Person:
Title:
Address:
Telephone Number

Applicant: Waterford Waterway Management District

Address: Post Office Box 416
Waterford, Wisconsin 53185

Title of Proposal: DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

Location: County: Racine City/Town/Village: Town and Village of Waterford

Township Range Section(s): U.S. Public Land Survey Sections 15, 23, 26, and 35, Township 4 North, Range 19 East, Town and Village of Waterford, Racine County

PROJECT SUMMARY

1. Brief overview of the proposal including the DNR action (include cost and funding source if public funds involved)

This Environmental Assessment (EA) addresses the potential impacts of dredging portions of the Waterford Impoundment in order to facilitate recreational boating access and water flows. The conduct of the proposed dredging project seeks to redress sediment inputs delivered, in part, to the Waterford Impoundment by large regional floods experienced during the period between 2007 through 2010.

2. Purpose and Need (include history and background as appropriate)

Sediment deposition within the Middle Illinois Fox River basin in Wisconsin has been an issue of concern for more than 35years. This issue is noted as being a principal issue in the formation of the Southeastern Wisconsin Fox River Commission (SEWFRC), and is an important element of the SEWFRC's initial implementation plan, and the updated plan published as Southeastern Wisconsin Regional Planning Commission (SEWRPC) Memorandum Report (MR) No.199, *Southeastern Wisconsin Fox River Commission Implementation Plan: 2011-2020*, during September 2011. Since the formation of the Waterford Waterway Management District (WWMD) and the publication of SEWRPC Community Assistance Planning Report (CAPR) No. 283, *A Lake Management Plan for the Waterford Impoundment, Racine County, Wisconsin*, in October 2007, sediment management in the Impoundment has been acknowledged as an

issue of concern by both special purpose governmental units (SEWFRC and WWMD). The two plans (SEWRPC Memorandum Report No. 199 and Community Assistance Planning Report No. 283) noted impediments to navigation caused by the deposition of unconsolidated sediment within the upper reaches and embayments of the Impoundment, and recommended measures to manage these accumulations. Removal and management of the sediment would require an Environmental Assessment (EA) as the proposed project includes a Type II action, as defined in Section NR 150.03(8)(f)1.a. of the *Wisconsin Administrative Code*: "The removal of 3,000 cubic yards or more of material." This action has the potential to cause significant environmental effects and may involve unresolved conflicts in the use of available resources. This EA addresses those issues.

3. Authorities and Approvals (list local, state and federal permits or approvals required)

This EA is prepared pursuant to the requirements of Chapter NR 150 of the *Wisconsin Administrative Code*, and addresses the removal and management of material from the bed of a navigable waterway of the State. The Wisconsin Department of Natural Resources (WDNR) has authority to regulate the removal of materials from all navigable waters pursuant to Section 30.20 of the *Wisconsin Statutes*.

The applicant is a duly constituted public inland lake protection and rehabilitation district created pursuant to Chapter 33 of the *Wisconsin Statutes*. Public inland lake protection and rehabilitation districts are a "local governmental unit" as defined in Section 30.79(1)(a) and a "municipality" for purposes of intergovernmental cooperation as defined in Section 66.0301(1)(a) of the *Wisconsin Statutes*. Public inland lake protection and rehabilitation districts, as a "municipal corporation," are included within the definition of a "person" as set forth in Section 32.01(1) the *Wisconsin Statutes* and related to the exercise of eminent domain.

PROPOSED PHYSICAL CHANGES (more fully describe the proposal)

4. Manipulation of Terrestrial Resources (include relevant quantities - sq. ft., cu. yard, etc.)

This proposal creates approximately 383,300 cubic yards of dredge spoil which are proposed to be disposed onto agricultural lands in the vicinity of the Waterford Impoundment. Appropriate disposal sites are currently being investigated. The land area available for dredge spoil disposal will inform the choice of dredging technique and the prior manipulation of the dredged materials prior to disposal—for example, consideration will be given to using centrifugal dewatering techniques prior to land disposal of the solids rather the more traditional pumping of slurry into confined disposal facilities. This would reduce return flows and minimize the land area required for the construction of dredge spoil disposal dams. The transport of dredge spoils will be conducted in accordance with the requirements set forth in Chapter NR 500 through NR 504 of the *Wisconsin Administrative Code*.

5. Manipulation of Aquatic Resources (include relevant quantities - cfs, acre feet, MGD, etc.)

This proposal affects approximately 157,600 cubic yards of unconsolidated sediment deposited within the principal flow channel/former channel of the impounded Fox River within an area defined by N. Bridge Road in the Town of Waterford at the northern extreme and the Waterford dam in the Village of Waterford at the southern extreme. In addition, the proposal affects a further volume of approximately 225,700 cubic yards of unconsolidated sediment that has accumulated in the tributary embayments within this flowage. The WWMD proposes to remove these unconsolidated sediments in order to establish navigational channels along the mainstem of the Impoundment (dimensions of five feet in depth and 100feet in width at the 5-foot depth); side slopes of 10H:1V are proposed. In the embayments, the dimensions proposed are a 5-foot depth and a 50-foot width at the 5-foot depth and side slopes of 3H:1V. The dredging program will be centered on those areas of the Impoundment having developed riparian properties, and will avoid those areas of the Impoundment adjacent to wetlands and natural areas, such as occur adjacent to the Tichigan State Wildlife Area, for example.

6. Buildings, Treatment Units, Roads and Other Structures (include size of facilities, road miles, etc.)

There are no buildings, roads, or other structures affected by the proposal. Depending on the choice of dredging technique and on the dewatering method(s) selected, areas adjacent to the Impoundment may experience increased vehicular traffic, use of culverts or other road crossings may be considered as routes for pipes associated with the

pumping of dredge spoil slurries, and temporary pads may be required to the location of booster pumps depending on the distance between the dredging site and locations of the disposal areas.

7. Emissions and Discharges (include relevant characteristics and quantities)

Approximately 383,300 cubic yards of sediment will be deposited onto the land surface in identified confined disposal facilities, the locations of which are to be determined. Depending on the dredging method employed, and on the possible use of centrifugal dewatering techniques, an unknown volume of water could be generated as a return flow to the Waterford Impoundment from the sludge disposal sites. Return flow water quality will conform to the requirements set forth in the applicable Wisconsin Pollution Discharge Elimination System (WPDES) permit requirements pursuant to Chapter 283 of the *Wisconsin Statutes*. Confined disposal facilities will be constructed in accordance with applicable State standards, as set forth in, among others, Chapter NR 347 of the *Wisconsin Administrative Code*. No atmospheric discharges will occur.

8. Other Changes

Completion of the proposed dredging project will enhance public safety by assuring the creation (and maintenance) of navigational lanes within and adjacent to the Waterford Impoundment. Provision of demarcated lanes accommodating recreational boating traffic utilizing the Waterford Impoundment also will minimize disturbances to those areas of the Impoundment considered to be high value aquatic habitat; namely, the areas of the northernmost embayment locally known as Conservancy Bay which are located adjacent to the Tichigan State Wildlife Area.

9. Identify the maps, plans and other descriptive material attached

Attachment 1: SEWRPC Staff Memorandum, "Feasibility Assessment of Dredging of the Waterford Waterway for Flood Flow Management and Navigational Access," December 2012.

AFFECTED ENVIRONMENT (describe existing features that may be affected by proposal)

10. Information Based On (check all that apply):

☒ Literature/correspondence (specify major sources)

SEWRPC Community Assistance Planning Report No. 137, *A Park and Open Space Plan for Waukesha County*, December 1989.

SEWRPC Community Assistance Planning Report No. 283, *A Lake Management Plan for the Waterford Impoundment, Racine County, Wisconsin*, Volume One, *Inventory Findings*, October 2007.

SEWRPC Memorandum Report No. 93, *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, March 1995.

SEWRPC Planning Report No. 12, *A Comprehensive Plan for the Fox River Watershed,* Volume One*, Inventory Findings and Forecasts***,** April, 1969.

SEWRPC Planning Report No. 30, *A Regional Water Quality Management Plan for Southeastern Wisconsin–2000,* Volume Two*, Alternative Plans*, February 1979.

SEWRPC Planning Report No. 42, *A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997, as refined.

Wisconsin Conservation Department Report, *Surface Water Resources of Racine County*, 1961.

Wisconsin Department of Natural Resources Lake Use Report No. FX- 6, *Waterford Impoundment and Tichigan Lake, Racine County, Wisconsin*, 1970.

Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2005, *Wisconsin Lakes*, 2005.

Wisconsin Department of Natural Resources, *Waterway and Wetland Handbook, Chapter 130: Water Levels and Flow*, November 2004.

Wisconsin Department of Natural Resources, *Waterway and Wetland Handbook, Chapter 140: Dams*, November 2004.

☒ Personal Contacts (list in item 26)

Field Analysis By: ☒ Author ☒ Other (list in item 26)

Past Experience With Site By: ☒ Other (list in item 26)

11. Physical Environment (topography, soils, water, air)

Topography and Bathymetry

The Waterford Impoundment is located in the Village and Town of Waterford, south of the City of Waukesha. The Impoundment is a flow-through lake with extensive shallow areas and a single deep basin, located on the Illinois-Fox River. The lake level is augmented by an impoundment and is controlled by two outlet control structures located on the southern shore of the Lake. The western structure is fitted with Tainter Gates that can be adjusted to control water levels within the Impoundment, while the eastern structure is a fixed crest spillway. As a consequence of Impoundment, the Waterford flowage not only impounds the middle portion of the Fox River, but also links the pre-existing natural lakes—Tichigan Lake and Buena Lake—into the waterway.

The northern portions of the Impoundment are characterized by the presence of extensive areas of wetland, known as the Tichigan State Wildlife Area. Several smaller tributary streams drain through the wetlands into the portion of the Impoundment known as Conservancy Bay. The Fox River enters this Bay from the north, and is subject to the backwater effect of the Impoundment for some additional distance upstream.

The characteristics of the Impoundment have typically been stated in terms of the characteristics of the two natural lakes encompassed within the Impoundment, Tichigan Lake and Buena Lake. The Wisconsin Conservation Department, in the publication entitled *Surface Water Resources of Racine County*, published in 1961, noted that Buena Lake had a surface area of 108 acres, a maximum depth of 8 feet, and a shoreline development factors of 2.68—this latter value indicating that the length of the Buena Lake shoreline was about 2.7 times that of a circle with the same surface area. The same publication reported that Tichigan Lake had a surface area of 268 acres, a maximum depth of 63 feet, and a shoreline development factor of 2.07. Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2005, *Wisconsin Lakes*, published in 2005, reported the surface area of Buena Lake to be 72 acres, with a maximum depth of 8 feet, and the surface area of Tichigan Lake to be 279 acres, with a maximum depth of 65 feet and mean depth of 6 feet.

In contrast, SEWRPC Planning Report No. 12, *A Comprehensive Plan for the Fox River Watershed*, Volume One, *Inventory Findings and Forecasts*, published in April of 1969, suggested a surface area of 891 acres for Tichigan Lake and the portion of the Impoundment locally known as Conservancy Bay or the "widespread". This plan also noted a further area of 241 acres as being the surface area of Buena Lake, which would indicate that the total surface area of the Impoundment was about 1,132 acres. This surface area is similar to that reported in the Wisconsin Department of Natural Resources Lake Use Report No. FX- 6, *Waterford Impoundment and Tichigan Lake, Racine County, Wisconsin*, published in 1970, which included morphometric data for the system. This report noted a surface area of 1,132.8 acres. The report also stated a maximum depth of 63 feet (in Tichigan Lake), a mean depth of 6.3 feet, and a shoreline development factor of 5.94. About a decade later, SEWRPC Planning Report No. 30, *A Regional Water Quality Management Plan for Southeastern Wisconsin–2000*, Volume Two, *Alternative Plans*, published in February 1979, stated that the Waterford Impoundment-Buena Lake-Tichigan Lake complex had a surface area of 1,374 acres, a maximum depth of 63 feet [in Tichigan Lake] and 8 feet [in Buena Lake], and a mean depth of 6 feet. In SEWRPC Memorandum Report No. 93, *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, published in March 1995, the surface area of the Impoundment, inclusive of Buena and Tichigan Lakes, was reported to be 1,133 acres, with a maximum depth of 63 feet, and a mean depth of 6 feet. Most recently, SEWRPC Community Assistance Planning Report No. 283, *A Lake Management Plan for the Waterford Impoundment, Racine County, Wisconsin*, Volume One, *Inventory Findings*, published in October 2007, noted that the Waterford Impoundment had a surface area of about 1,132 acres, with a maximum depth, in Tichigan Lake, of about 65 feet, and, in Buena Lake, of about 8 feet.

This latter plan also noted that approximately 32 percent of the Impoundment area is less than three feet deep, while about 8 percent of the Impoundment has a water depth of more than 20 feet. The Waterford Impoundment is approximately 4.2 miles long and about 1.4 miles wide at its widest point. The major axis of the Impoundment lies in a generally north-south direction. The Impoundment shoreline is approximately 24 miles long, with a shoreline development factor of 4.9, indicating that the shoreline is about five times longer than a circular lake of the same area. This is consistent with the elongate nature of the waterbody. The Impoundment has a total volume of approximately 7,113 acre-feet. The water level in the Waterford Impoundment is primarily determined by the twin spillways—one fixed crest and one gated—of the Waterford Dam located in the Village of Waterford. As established by the dam's operating permit, issued by the WDNR to Racine County, the level of the Lake is maintained at an elevation of about 773.4 feet National Geodetic Vertical Datum of 1929 (NGVD-29), or about 1.6 feet on the local datum located on the western wingwall of the western spillway of the Dam.

Soils

In 1966, the then U.S. Soil Conservation Service—now the U.S. Natural Resources Conservation Service (NRCS)—under contract to SEWRPC completed a detailed soil survey of the entire seven-county Region. This survey was published as SEWRPC Planning Report No. 8, *The Soils of Southeastern Wisconsin*, June 1966. This soil survey included interpretations for planning and engineering applications and for suitability for various types of urban land uses, as well as for agricultural applications.

Soils within the area directly tributary to the Waterford Impoundment were categorized generally into four main hydrologic groups: 56 percent of the soils were categorized as type B soils that are moderately well drained, coarse and fine textured, with moderately rapid to moderate permeability and a low to moderate shrink-swell potential. Of the balance, 20 percent were categorized as type D soils that are very poorly drained, organic or clay soils having a high shrink-swell potential, and 15 percent were categorized as type C soils that are poorly drained. The remainder could not be categorized.

Major soil associations found in the area directly tributary to the Waterford Impoundment are: the Morley-Beecher-Ashkum association of well-drained to poorly drained soils that have a silty clay or silty clay loam subsoil, the Hebron-Montgomery-Aztalan association of well-drained to poorly drained soils that have a loam to silty clay subsoil, the Fox-Casco association of well-drained soils that have a clay loam and silty clay loam subsoil, the Houghton-Palms association of very poorly drained organic soils, and the Miami association of well-drained soils that have a silty clay loam and clay loam subsoil. In addition, the major soil types present within the tributary area include: Navan silt loam, Aztalan loam, Morley silt loam, Darroch fine sandy loam, Zurich silt loam and Marsh soils.

Water Resources

Climate

The mean annual temperature in the vicinity of the Waterford Impoundment is 48.2°F, as measured at Waukesha. This temperature is similar to that reported from other recording locations in southeastern Wisconsin. The mean annual precipitation at Waukesha is about 34.64 inches, more than half of which falls during the growing season, from May to September. Runoff rates are generally low during this period, since evapotranspiration rates are high, vegetative cover is good, and soils are not frozen. Normally, about 20 percent of the summer precipitation is expressed as surface runoff, but intense summer storms occasionally produce higher runoff fractions. In contrast, the approximately 45 percent of the annual precipitation occurs during the winter or early spring when the ground is frozen, and may result in high surface runoff during those seasons.

12. Biological Environment (dominant aquatic and terrestrial plant and animal species and habitats including threatened/endangered resources; wetland amounts, types and hydraulic value)

Aquatic Plants

Data on the algal community of the Waterford Impoundment were acquired by the U.S. Environmental Protection Agency (USEPA) during 1972. USEPA reported that the algal community was dominated by diatoms. *Cyclotella* and *Stichococcus* were the dominant genera during summer, with *Cyclotella* and *Stephanodiscus* being dominant in

winter. Other genera observed during the summer months included the diatoms *Navicula* and *Nitzschia*, as well as *Synedra*, *Oocystis*, and *Scenedesmus*. During the winter months, other genera present included the diatoms, *Fragilaria* and *Navicula*, and *Phacus*.

An aquatic plant survey of the Waterford Impoundment was conducted by SEWRPC staff during July 2003. Twelve species of submergent aquatic plants were identified in the Waterford Impoundment, with the most commonly occurring aquatic plant, coontail (*Ceratophyllum demersum*), being found at only approximately one-half of the sites sampled. Eurasian water milfoil (*Myriophyllum spicatum*) was the next most commonly occurring aquatic plant, being present at less than one-third of the sites sampled. In general, the aquatic plant community of the Waterford Impoundment can be described as sparse.

Fish

The WDNR conducted fish surveys on the Tichigan Lake subbasin in April and August 2000. The survey included electrofishing along four miles of shoreline and deployment of mini-fyke nets. Sixteen species of fish were captured during these surveys. Game fish observed during the survey included, northern pike (*Esox lucius*), largemouth bass (*Micropterus salmoides*), and walleye (*Stizostedion vitreum vitreum*). Numbers of panfish were also caught, including bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*) and pumpkinseed (*Lepomis gibbosus*). Some rough fish, including carp (*Cyprinus carpio*) were also collected.

Important predator fish in Tichigan Lake include largemouth bass, walleye, and northern pike. Walleye were the most abundant gamefish, ranging in length from 13.9 to 21.3 inches. Northern pike ranged in length from 5.4 to 30.1 inches; and largemouth bass ranged from 10.1 to 18.5 inches. All of these species are carnivorous, feeding primarily on other fish, crayfish, and frogs. These species also are among the largest and most prized game fish sought by Tichigan Lake anglers. Historically, northern pike and walleye have been stocked in alternate years.

A wide range of panfish was also present in the Lake, of which bluegill were the most abundant, followed by warmouth, pumpkinseed, yellow bullhead and green sunfish. “Panfish” is a common term applied to a broad group of smaller fish with a relatively short and usually broad shape that makes them a perfect size for the frying pan. The habitats of panfish vary widely among the different species, but their cropping of the plentiful supply of insects and plants, coupled with prolific breeding rates, leads to large populations with a rapid turnover. Some lakes within southeastern Wisconsin have stunted or slow-growing panfish populations. These occur because the numbers of panfish are not controlled by predator fishes.

Terrestrial Wildlife

A variety of mammals, ranging in size from large animals like the northern white-tailed deer to small animals like the least shrew, are expected to be found in the Waterford Impoundment area. Mink, muskrat, beaver, white-tailed deer, red and grey fox, grey and fox squirrel, and cottontail rabbits are mammals reported to frequent the area.

A large number of birds, ranging in size from large game birds to small songbirds, also are expected to be found in the Waterford Impoundment area. The Waterford Impoundment tributary area also supports a significant population of waterfowl, including mallard and teal. Larger numbers of birds move through the tributary area during migrations when most of the regional species may also be present. Mallards, wood ducks, blue-winged teal and Canada geese are the most numerous waterfowl and are known to nest in the area. Many game birds, songbirds, waders, and raptors also reside or visit the Lake and its environs. Ospreys and loons are notable migratory visitors. Because of the mixture of lowland and upland woodlots, wetlands, and agricultural lands still present in the area, along with the favorable summer climate, the area supports many other species of birds. Hawks and owls function as major rodent predators within the ecosystem. Swallows, whippoorwills, woodpeckers, nuthatches, and flycatchers, as well as several other species, act as major insect predators. In addition to their ecological roles, birds such as robins, red-winged blackbirds, orioles, cardinals, kingfishers, and mourning doves serve as subjects for bird watchers and photographers. Threatened species migrating in the vicinity of the Waterford Impoundment include the Cerulean warblers, the Acadian flycatcher, great egret, and the Osprey.

Amphibians and reptiles are vital components of the ecosystem in an environmental unit like the Waterford Impoundment tributary area. Examples of amphibians native to the area include frogs, toads, and salamanders. Turtles and snakes are examples of reptiles common to the Waterford Impoundment area. Fourteen amphibian and fifteen reptile species normally are expected to be present in the Waterford Impoundment area under current conditions. Many amphibians and reptiles have definite habitat requirements that are adversely affected by advancing urban development, as well as by certain agricultural land management practices. The major detrimental factors affecting the maintenance of amphibians in a changing environment is the destruction of breeding ponds, urban development occurring in migration routes, and changes in food sources brought about by urbanization.

Threatened, Endangered and Special Concern Species
Endangered species migrating in the vicinity of the Waterford Impoundment include the common tern, Caspian tern, Forster's tern, and the loggerhead shrike.

Non-native and Invasive Species
The presence of Eurasian water milfoil in the Waterford Impoundment is cause for concern. Eurasian water milfoil can exhibit "explosive" growth under suitable conditions, such as in the presence of organic-rich sediments or where the lake bottom has been disturbed. It reproduces by the rooting of plant fragments, and has been known to cause severe recreational use problems
in lakes in southeastern Wisconsin, reducing the biodiversity of the lakes and degrading the quality of fish and wildlife habitats.

Purple loosestrife, *Lythrium salicaria*, another nonnative nuisance plant, has been present in the wetlands and riparian areas surrounding the Impoundment. Like Eurasian water milfoil, purple loosestrife is known to spread profusely, outcompeting native plant growth and reducing the quality of fish and wildlife habitat while adding little ecological benefit. Purple loosestrife is subject to an ongoing eradication program. Also present in the tributary area of the Waterford Impoundment was the first documented colony in Wisconsin of golden or yellow loosestrife, *Lysimachia punctata*, a more aggressive nonnative relative of purple loosestrife.

The zebra mussel, *Dreissena polymorpha*, an invasive species with known negative impacts on native benthic populations, has been observed in areas of the Waterford Impoundment. Zebra mussels disrupt the food chain by removing significant amounts of phytoplankton from the water, which are food for larval and juvenile fish, which are in turn food for game fish. The overall effect is that as zebra mussels and other invasive species spread to inland lakes and rivers, so do the environmental, aesthetic, and economic costs to water users.

Wetlands
Wetlands, as defined by SEWRPC, are "areas that have a predominance of hydric soils and that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions." This definition, which is also used by the U.S. Army Corps of Engineers (USACE) and the USEPA, is essentially the same as the definition used by the U.S. Natural Resource Conservation Service (NRCS), although it differs slightly from the definition set forth in Chapter 23 of the Wisconsin Statutes, and used by the WDNR. Chapter 23 defines a wetland as "an area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation, and which has soils indicative of wet conditions." In practice, the WDNR definition differs from the SEWRPC definition in that the WDNR considers very poorly drained, poorly drained, and some of the somewhat poorly drained soils as wetland soils meeting the WDNR "wet condition" criterion. The SEWRPC definition only considers the very poorly drained and poorly drained soils as meeting the "hydric soil" criterion. This definition is more inclusive than the Federal and SEWRPC definitions in that the WDNR may include some soils that do not show hydric field characteristics as wet soils capable of supporting wetland vegetation, a condition that may occur in some floodlands.

A significant area of marshland is contained within the Vernon Marsh, a State natural area located on the mainstem of the Fox River within the Towns of Mukwonago, Vernon, and Waukesha. The major wetland communities located in the area tributary to the Waterford Impoundment included deep and shallow marsh, sedge meadow, fresh (wet)

meadow, shrub carr, southern wet to wet-mesic hardwoods, and a fen. Sedge meadows are considered to be stable wetland plant communities that tend to perpetuate themselves if dredging activities and water level changes are minimized. Sedge meadows in southeastern Wisconsin are characterized by the tussock sedge (*Carex stricta*) and, to a lesser extent, by Canada blue-joint grass (*Calamagrostis canadensis*). Sedge meadows that are drained or disturbed to some extent typically succeed to shrub carrs. Shrub carrs, in addition to the sedges and grasses found in the sedge meadows, contain an abundance of shrubs such as willows (*Salix* spp.) and red osier dogwood (*Cornus stolonifera*). In extremely disturbed shrub carrs, the willows, red osier dogwood, and sedges are replaced by such exotic plants as honeysuckle (*Lonicera* sp.), buckthorn (*Rhamnus* sp.), and the very aggressive reed canary grass (*Phalaris arundinacea*). Fresh (wet) meadows are essentially lowland meadows which are dominated by forbes such as the marsh (*Aster simplex*), swamp (*Aster lucidulus*), and New England (*Aster novae-angliae*) asters, and giant goldenrod (*Solidago gigantea*). Deep and shallow marsh areas are dominated by cattails (*Typha* spp.). Other emergent plant species commonly occurring in the deep and shallow marshes within the Waterford Impoundment tributary basin include bur-reed (*Sparganium eurycarpum*), Arrow-head (*Sagittaria latifolia*), reed grass (*Phragmites communis*), bulrushes (*Scirpus* spp.), lake sedge (*Carex lacustris*), and water-willow (*Decodon verticillatus*).

Woodlands

Woodlands are defined by the Regional Planning Commission as those areas containing a minimum of 17 trees per acre with a diameter of at least four inches at breast height (4.5 feet above the ground). Lowland forests in the Waterford Impoundment tributary basin include southern wet to wet-mesic hardwood forests scattered throughout the total tributary basin. These forests also are characterized by black willow, cottonwood, green ash, and American elm. Upland woodlands in the Waterford Impoundment tributary basin include southern dry hardwood forests, which are characterized by white oak (*Quercus alba*), shagbark hickory (*Carya ovata*), and black cherry (*Prunus serotina*); southern dry-mesic hardwood forests characterized by northern red oak (*Quercus borealis*) and white ash (*Fraxinus americana*); southern mesic hardwood forests dominated by sugar maple (*Acer saccharum*) and basswood (*Tilia americana*); wet-mesic hardwood forests dominated by green ash (*Fraxinus pennsylvania*), American elm (*Ulmus americana*), and silver maple (*Acer saccharinum*) and wet hardwood forests dominated by black willow (*Salix nigra*) and cottonwood (*Populus deltoides*). The major tree species include the black willow, cottonwood, green ash, silver maple, American elm, basswood, northern red oak, and shagbark hickory. Some isolated stands of tamarack (*Larix laricina*) also exist in the tributary area, together with such other upland species as the white oak, burr oak (*Quercus macrocarpa*), black cherry, and sugar maple.

Environmental Corridor Lands

Primary environmental corridors were first identified within the Region in 1963 as part of the original regional land use planning effort of SEWRPC and were subsequently refined under the Commission watershed studies and regional park and open space planning programs. The primary environmental corridors in Southeastern Wisconsin generally lie along major stream valleys and around major Lakes and contain almost all the remaining high-value woodlands, wetlands, and wildlife habitat areas, and all the major bodies of surface water and related undeveloped floodlands and shorelands. The primary environmental corridors in the area directly tributary to the Waterford Impoundment in 2000 encompassed about 2,803 acres, or 19 percent of the tributary area. These lands include the privately owned Elm Island-Bog Island Oak Woods, totaling 68 acres; the Tichigan Fen, comprising 118 acres; Norris Marsh and Slough, consisting of 180 acres in Racine County and 32 acres in Waukesha County; and, VanValin Woods, composed of 30 acres. In addition, the Tichigan Marsh, Tichigan Wetlands and Low Woods, and Tichigan Wet Prairie are owned by the WDNR.

13. Cultural Environment

a. Land use (dominant features and uses including zoning if applicable)

The 1970 Wisconsin Department of Natural Resources Lake Use Report No. FX-6, *The Waterford Impoundment and Tichigan Lake, Racine County, Wisconsin*, reported that, as of 1963, about 14 percent of the total area tributary to the Waterford Impoundment was devoted to urban land uses with the dominant urban land use being residential, encompassing about 48 percent of urban lands. At that time, about 86 percent of the area tributary to the Waterford Impoundment was devoted to rural uses, 72 percent of which were agricultural.

As of 2000, urban land uses encompassed about 76,000 acres, or 33 percent of the total area tributary to the Waterford Impoundment, with residential land uses encompassing about 44,000 acres, or 57 percent of the area in urban use. About 155,000 acres, or 67 percent of the total area tributary to the Waterford Impoundment, were devoted to rural land uses, with about 92,600 acres, or about 60 percent of the rural area, being in agricultural land uses. Woodlands, wetlands, and surface waters, including the surface area of the Waterford Impoundment, accounted for approximately 60,000 acres, or 39 percent of the area in rural uses.

By 2020, urban land uses are expected to increase in areal extent to about 76,225 acres, or about 33 percent of the total tributary area, with urban residential uses expected to increase from about 43,596 acres, as of 2000, to about 60,868 acres in the year 2020. Agricultural lands in the tributary area, consequently, are expected to decrease in areal extent to about 61,860 acres in the year 2020. Recent surveillance indicates that such changes in land usage appear to be due to large-lot residential development. If this trend continues, some of the open space areas remaining in the tributary area are likely to be replaced with large-lot urban residential development, resulting in the potential for increased pollutant loadings to the waterbody, although, with respect to sediment loads, such development would be expected to generate less sediment once the impervious surfaces and lawns are in place.

b. Social/Economic (including ethnic and cultural groups)

The area directly tributary to the Waterford Impoundment includes portions of the Town and Village of Waterford and the Town of Norway. The total area tributary to the lake extends northerly through much of Waukesha County into the southernmost portions of Washington County.

The number of residents in the area directly tributary to the Waterford Impoundment (that area which drains directly to the Waterford Impoundment without passing through any upstream waterbodies) was about 3,150 in 1963 and has increased relatively steadily since that time, with the largest increase occurring between 1990 and 2000. This same decade, 1990-2000, also experienced great population increase in the total tributary area (the entire upstream area draining to the Waterford Impoundment). An estimated 884 households were present in the direct tributary area of Waterford Impoundment in 1963, which number had increased to about 2,884 by 2000. The continued increase in population and the number of resident households in the area tributary to the Waterford Impoundment is expected to be accommodated as agricultural lands in the tributary area are converted to urban residential uses.

The Waterford Impoundment fishery has been supported by the WDNR stocking programs, with northern pike and walleye being stocked in alternate years. WDNR fisheries surveys indicate that the Impoundment supports an excellent panfish stock, as well as populations of largemouth bass, walleyed pike and northern pike. Evidence of the good fishing is provided by the relatively large numbers of fishing boats and shoreline anglers using the Impoundment during the summer. During July 2003, boat counts by SEWRPC staff resulted in a total of about 1,442 watercraft of all descriptions, fishing, pontoon, skiing, sailing, and rowing vessels and personal watercraft, being recorded. Of these watercraft, at the Fox River survey site, a total of 15 watercraft were observed by SEWRPC staff to be in use on a typical weekday compared with 69 watercraft of various types during a typical weekend. At the Tichigan Lake survey site, a total of 31 watercraft were observed to be in use during a typical weekday compared with 94 watercraft of various types in use on a typical weekend. Nonboating recreational uses were observed at the Tichigan Lake survey site including sunbathing, picnicking and enjoying the aesthetics provided by a waterbody. Comparison of data from the two survey sites supports the public perception that the Impoundment is heavily used, especially on weekends. The densities of high-speed watercraft, comprised of pleasure boating, water skiing, and jet skiing, on the 268-acre Tichigan Lake during a one-hour count ranged from about one boat per 22 acres on a typical weekday, to about one boat per 3.5 acres on a typical weekend. Such densities exceed those considered appropriate for the conduct of safe high speed boating activities pursuant to the adopted Regional guidelines.

c. Archaeological/Historical

The movement of European settlers into the Southeastern Wisconsin Region began about 1830. Completion, within Southeastern Wisconsin, of the U.S. Public Land Survey in 1836, and the subsequent sale of public lands

in Wisconsin, brought a rapid influx of settlers into the area. Urban development began to occur within the area tributary to the Waterford Impoundment shortly after the completion of the U.S. Public Land Survey, with the earliest development occurring within the current Village of Waterford area. Significant urban development began during the 1920s and continued to surge with major land use development occurring in the years following World War II until the present time. The number of residents in the tributary area has increased relatively steadily since that time, with the largest increase occurring between 1990 and 2000.

14. Other Special Resources (e.g., State Natural Areas, prime agricultural lands)

The Tichigan State Natural Area, adjoining the northwestern shoreline of the Impoundment, is a portion of a 750- acre reserve comprised of calcareous fen and deep and shallow marsh, bordered by dry, dry-mesic, and wet-mesic woods and sedge meadow.

ENVIRONMENTAL CONSEQUENCES (probable adverse and beneficial impacts including indirect and secondary impacts)

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15. Physical (include visual if applicable)

The immediate impact of the conduct of the proposed dredging project will be the removal of approximately 383,300 cubic yards of unconsolidated sediment from the major navigational channels within the Impoundment, and the placement of the dredge spoil upon adjacent agricultural lands.

The initial physical impact would involve the mobilization of the sediment from the bed of the waterway. The degree of disturbance would be related to the choice of dredging method, which at this time is expected to be hydraulic dredging. The materials to be removed consist primarily of unconsolidated sediment deposited in the Impoundment. Little, if any, parent material is expected to be removed in this process. Along the mainstem of the Impoundment, the sediments to be removed have been deposited into the historic river channel. The dredging project will seek to restore this historic channel to the extent practicable within the dimensions proposed (i.e., 100-foot bottom width, five-foot depth, and 10H:1V side slopes). In the bays, the dredging effort will be limited to those areas adjacent to riparian homesteads and businesses. Channel dimensions in these areas will be about a 50-foot width, five-foot depth, and 3H:1 side slopes.

To minimize transportation of silts, silt curtain will be employed to limit the impact of resuspended sediments outside of the dredging area.

Secondary impacts are anticipated at the point of discharge of the dredge spoils, whether these be into a confined disposal facility as a slurry to onto farm fields as centrifugate. It is anticipated that in any event some further drying of the dredge spoil will be required before it can be incorporated into the fields using standard tilling techniques. It is possible that some odors may arise at this stage of the dredging project, although these concerns are likely to be temporary.

Additional temporary physical impacts would be associated with the placement of pipe required to transfer the dredged material to the disposal sites. Pipes would be required to transport the slurry from the dredge to the disposal area; portions of the pipe would be laid along the lake bed and portions would lie along the land surface. Depending on the disposal method, the temporary presence of berms forming the confined disposal facilities would be required. Associated with these facilities would be an additional pipe to convey return flows back to the Lake from the disposal areas. Possible routes to be selected for these purposes should avoid environmentally sensitive areas (as noted under items 16 and 20b, below).

16. Biological (including impacts to threatened/endangered resources)

Biological impacts are likely to be minimal, given the nature of the sediments being removed. Few organisms known to occur in the Impoundment utilize unconsolidated sediments as substrate. Fishes would be expected to move away from the areas of disturbance created by the dredging process. Mussel species, most likely to be impacted as a result of the dredging process, are unlikely to utilize unconsolidated sediments as habitat, and areas of the Impoundment having substrates more conducive as mussel habitat are not proposed to be disturbed. Similarly, areas of the

Impoundment on the fringe of the State Wildlife Area are outside of the project area, and are not likely to be disturbed.

There is some potential for biological impact following dredging and disposal of the dredge spoil. In the waterway, this potential impact is related to the possibility that nonnative aquatic plants, such as Eurasian water milfoil, which currently exist within the River system could find the disturbed conditions an ideal area for growth. Eurasian water milfoil is a well known early colonizer of organic substrates following periods of disturbance. The WWMD would monitor these areas for pioneer colonies of Eurasian water milfoil and undertake measures to minimize such growths; measures would most likely be based upon the application of chemical herbicides, which currently form the primary aquatic plant management practice in the waterway.

Similarly, within the terrestrial environment at the disposal sites, there is the possibility that nonnative pioneering species may seek to colonize the confined disposal facilities. This possibility will be minimized by the planting of a cover crop at the earliest opportunity as drying occurs. Once drying is considered to be complete, the material will be ploughed in and incorporated into the agricultural soils and subject to ongoing farming practices, inclusive of "weed" control. Disturbance to areas of natural vegetation is not anticipated; any such disturbance, such as that which may arise from the placement of pipe and pumping facilities, is expected to be temporary.

17. Cultural

a. Land Use (including indirect and secondary impacts)

Placement of pipe and disposal of dredge spoils on agricultural lands adjacent to the waterway are likely to have a temporary land use impact. Once the dredged material is dried out and incorporated into the agricultural soils, the only longer term impact is expected to be some increase in soil fertility in those areas into which dredge spoil is incorporated. There is a small likelihood of odor problems being experienced by adjacent land owners. Selection of dredge spoil disposal sites will be undertaken with this concern in mind.

b. Social/Economic (including ethnic and cultural groups, and zoning if applicable)

Positive societal benefits are anticipated to arise from the completion of the dredging project. In the first instance, the major recreational boating pathways within the Impoundment and associated access lanes are expected to become more navigable. Using agricultural lands for dredge spoil disposal is unlikely to conflict with the zoning status of these properties. Landowner agreements would be obtained prior to transport or disposal of dredged materials across private lands.

c. Archaeological/Historical

Areas proposed to be disturbed by the dredging project are agricultural lands that are already in a state of disturbance. Materials removed from the lakebed are principally unconsolidated sediments transported into the Impoundment from areas upstream in the watershed area. Consequently, these sediments are unlikely to contain materials of archaeological or historical value.

18. Other Special Resources (e.g., State Natural Areas, prime agricultural lands)

The proposed dredging project is not anticipated to affect the Tichigan State Wildlife Area or other environmentally sensitive areas of the Impoundment. The primary areas of disturbance will be limited to the thalweg of the Impoundment and to areas already subject to disturbances from adjacent riparian property owners, including disturbances such as placement of piers, operation of watercraft, or installation of shoreland protection structures. Placement of nutrient-rich sediments on agricultural lands can be expected to have a beneficial impact on such lands, once the dredge spoils have dried and been incorporated into the soil profiles.

19. Summary of Adverse Impacts That Cannot Be Avoided (more fully discussed in 15 through 18)

The principle disturbances associated with the proposed dredging project are largely temporary in nature. Such temporary disturbances include: limited resuspension of in-lake unconsolidated sediments which will be controlled to the extent possible by placement of silt curtains during the dredging process; limited obstruction of the navigational

area by the dredger and associated conveyance and return flow pipe; disturbance of terrestrial areas by the placement of pipe and pumping facilities needed to convey the dredged slurry to the disposal areas; and occupation of the land surface by constructed disposal facilities during the period of drying of the dredged materials on agricultural fields. All of these impacts are expected to result in only temporary disturbances during the project period. Once the project is completed, expected benefits related to improved navigability are anticipated.

SEWRPC EVALUATION OF PROJECT SIGNIFICANCE (complete each item)

20. Environmental Effects and Their Significance

a. Discuss which of the primary and secondary environmental effects listed in the environmental consequences section are long-term or short-term.

Short-term impacts would be anticipated during the dredging operations. These include possible increased turbidity and its concomitant effects on the fisheries and aquatic communities, although these impacts are proposed to be limited by the placement of silt curtains and staging of the dredging operations from upstream to downstream.

Limited obstruction of the navigational area by the dredger and associated conveyance and return flow pipe also is anticipated to be a short-term impact which will occur over a limited area of the Impoundment and for limited periods of time as the actual dredging operations proceed.

Disturbances of terrestrial areas by the placement of pipe and pumping facilities needed to convey the dredged slurry to the disposal areas also are expected to be limited to periods when the dredging operations are being conducted and for a short time thereafter as the dredged spoils are dried out and prior to the spoils being incorporated into the soil profiles. This period could be shortened by application of a centrifugal drying process prior to land disposal of the dredged spoils.

Finally, occupation of the land surface by constructed disposal facilities during the period of drying of the dredged materials on agricultural fields is expected to be of limited duration. As noted, this period could be shortened by application of a centrifugal drying process prior to land disposal of the dredged spoils.

b. Discuss which of the primary and secondary environmental effects listed in the environmental consequences section are effects on geographically scarce resources (e.g. historic or cultural resources, scenic and recreational resources, prime agricultural lands, threatened or endangered resources or ecologically sensitive areas).

Because the anticipated impacts are of largely limited duration, no long term impacts arising from the dredging project are expected. Short term disturbances associated with the dredging operations could include: noise associated with the operation of heavy equipment and dredging equipment, which could be mitigated by managing the timing of the dredging operations; limitation of navigation due to the placement of pipe, barges, and other infrastructure necessary to mobilize and convey the dredged materials from the lake bed to the disposal facility; and possible odors created during the drying process. All of these are expected to be of limited duration, and none are likely to affect scarce resources. Careful design of the dredging program will ensure that the dredging operations and associated disturbances occur away from environmentally sensitive areas and do not impact scenic and environmental resources.

c. Discuss the extent to which the primary and secondary environmental effects listed in the environmental consequences section are reversible.

No lasting, cumulative negative impacts are anticipated. Lasting benefits will include increased navigability within the Impoundment. Temporary and limited changes in in-lake turbidity might occur in the vicinity of the dredging operations. As also noted, temporary odors might occur in the vicinity of the disposal areas, while there might be some noise concerns associated with the operations. All of these potential impacts occur only during the period of the project.

Exhibit D (continued)

21. Significance of Cumulative Effects

Discuss the significance of reasonably anticipated cumulative effects on the environment (and energy usage, if applicable). Consider cumulative effects from repeated projects of the same type. Would the cumulative effects be more severe or substantially change the quality of the environment? Include other activities planned or proposed in the area that would compound effects on the environment.

Dredging projects have a limited longevity, and maintenance dredging operations following this project can be expected to be necessary. No lasting environmental impacts are anticipated, provided that similar safeguards, such as placement of silt curtains around the areas being actively dredged, are utilized during subsequent maintenance dredging operations.

22. Significance of Risk

a. Explain the significance of any unknowns that create substantial uncertainty in predicting effects on the quality of the environment. What additional studies or analysis would eliminate or reduce these unknowns?

Although the specific behavior of any given ecosystem is subject to natural variations, there is little uncertainty in the forecasts made in this environmental analysis. The practice and consequences of dredging projects are well known and all foreseeable impacts are proposed to be mitigated.

b. Explain the environmental significance of reasonably anticipated operating problems such as malfunctions, spills, fires or other hazards (particularly those relating to health or safety). Consider reasonable detection and emergency response, and discuss the potential for these hazards.

The environmental consequences of equipment failures are likely to be minor, except in the case of a pipeline breach which may result in the deposition of slurry in areas not intended to receive such materials. This risk will not occur if the dredge spoils are partially dewatered on site using centrifugal dewatering techniques or if the slurry is discharged into "geobags" or "geotubes" on the lake shore prior to these being dewatered and the sediments transported following dewatering. Other equipment failures, such a loss of power, are likely to delay the dredging process without causing environmental impacts.

There is a slight concern associated with the sediment quality of the dredged material, given that the Impoundment has been subject to various aquatic plant management practices over time, and given the large upstream watershed draining to the Impoundment. These risks are considered slight because sediment quality testing will be undertaken as part of the permitting process. Contaminated sediments, if any, will be identified and disposed of accordingly in secure locations, or left *in situ*, depending on location and nature of the contaminants,

23. Significance of Precedent

Would a decision on this proposal influence future decisions or foreclose options that may additionally affect the quality of the environment? Describe any conflicts the proposal has with plans or policy of local, state or federal agencies. Explain the significance of each.

Navigational dredging for recreational boating access is consistent with State policies governing water-related recreation. This project is not considered to be likely to establish or extend any precedents other than those already accepted as State policy.

24. Significance of Controversy over Environmental Effects

Discuss the effects on the quality of the environment, including socio-economic effects, that are (or are likely to be) highly controversial, and summarize the controversy.

There is significant sentiment within the Waterford Impoundment community in favor of maintaining navigability within the Impoundment. In fact, improving navigational access was a major platform in the establishment of the WWMD.

Exhibit D (continued)

ALTERNATIVES

25. Briefly describe the impacts of no action and of alternatives that would decrease or eliminate adverse environmental effects. (Refer to any appropriate alternatives from the applicant or anyone else.)

The no action alternative would continue the existing conditions within the Waterford Impoundment. Continued accumulation of sediments will further reduce opportunities for public access upstream of the Impoundment There would be ongoing environmental impacts associated with the no action alternative. These impacts include reduction in habitat and habitat quality for fishes and other aquatic organisms, water quality deterioration, and loss of recreational opportunities. By undertaking the main channel dredging portion of the project only, some reduction in risk to fishes and aquatic organisms, and improvement in recreational boating opportunities can be achieved. However, without concomitant dredging of the embayments, opportunities for the majority of the riparian residents to access the waterway will continue to degrade, as will breeding and other habitat for fishes and aquatic life that utilize these shallows for reproduction and foraging. Consequently, the project as proposed, inclusive of creating navigational channels along the thalweg of the Impoundment and connecting riparian residences to this navigational channel by selective dredging of the bays provides the greatest value to both humans and aquatic life. As in any dredging project, the dredged areas must be monitored for invasive aquatic plant infestations and measures taken to minimize the colonization of newly dredged area by species such as Eurasian water milfoil.

SUMMARY OF ISSUE IDENTIFICATION ACTIVITIES

26. List agencies, citizen groups and individuals contacted regarding the project (include DNR personnel and title) and summarize public contacts, completed or proposed).

Date	Contact	Comment Summary
2011	Dr Jeffrey A. Thornton (SEWRPC)	Conducted feasibility assessment documented in SEWRPC Staff Memorandum entitled “Feasibility Assessment of Dredging of the Waterford Waterway for Flood Flow Management and Navigational Access,” dated February 2012.

Exhibit D (continued)

Project Name: DREDGING OF THE WATERFORD WATERWAY FOR FLOOD FLOW MANAGEMENT AND NAVIGATIONAL ACCESS

County: Racine

DECISION (This decision is not final until certified by the appropriate authority)

In accordance with s. 1.11, Stats., and Ch. NR 150, Adm. Code, the Department is authorized and required to determine whether it has complied with s.1.11, Stats., and Ch. NR 150, Wis. Adm. Code.

Complete either A or B below:

A. EIS Process Not Required ☐

The attached analysis of the expected impacts of this proposal is of sufficient scope and detail to conclude that this is not a major action which would significantly affect the quality of the human environment. In my opinion, therefore, an environmental impact statement is not required prior to final action by the Department.

B. Major Action Requiring the Full EIS Process ☐

The proposal is of such magnitude and complexity with such considerable and important impacts on the quality of the human environment that it constitutes a major action significantly affecting the quality of the human environment.

Signature of Evaluator	Date Signed

Number of responses to news release or other notice:

Certified to be in compliance with WEPA	
Environmental Analysis and Liaison Program Staff	Date Signed

NOTICE OF APPEAL RIGHTS

If you believe that you have a right to challenge this decision, you should know that Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed.

For judicial review of a decision pursuant to sections 227.52 and 227.53, Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to file your petition with the appropriate circuit court and serve the petition on the Department. Such a petition for judicial review shall name the Department of Natural Resources as the respondent.

To request a contested case hearing pursuant to section 227.42, Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources. The filing of a request for a contested case hearing is not a prerequisite for judicial review and does not extend the 30-day period for filing a petition for judicial review.

Note: Not all Department decisions respecting environmental impact, such as those involving solid waste or hazardous waste facilities under sections 144.43 to 144.47 and 144.60 to 144.74, Stats., are subject to the contested case hearing provisions of section 227.42, Stats.

This notice is provided pursuant to section 227.48(2), Stats.