

# SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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May 10, 2017

Mr. Collin M. Johnson  
Floodplain Administrator  
City of Glendale  
5909 N. Milwaukee River Parkway  
Glendale, WI 53209

Dear Mr. Johnson:

Pursuant to the City of Glendale resolution adopted on December 14, 2016, requesting that the Southeastern Wisconsin Regional Planning Commission perform hydraulic analyses of the Milwaukee River, and the January 11, 2017, interagency meeting convened to discuss the City resolution and establish the parameters of the hydraulic analysis to be performed, we are providing you the results of our analysis in the attached SEWRPC Staff Memorandum, *Milwaukee River Hydraulic Analyses for the City of Glendale*, May 9, 2017.

We trust the analysis is fully responsive to the City's request. Please contact Joshua A. Murray of the Commission staff (262-953-3207, [jmurray@sewrpc.org](mailto:jmurray@sewrpc.org)) if you have any questions.

Sincerely,

A handwritten signature in black ink that reads "Michael G. Hahn".

Michael G. Hahn, P.E., P.H.  
Executive Director

MGH/LKH/JAM/mid  
00237090.DOCX

cc: Ms. Rachel Reiss, City of Glendale  
Mr. Thomas Chapman, MMSD  
Mr. John Dargle, Milwaukee County  
Mr. Kevin Haley, Milwaukee County  
Mr. Teig Whaley-Smith, Milwaukee County  
Mr. Theodore Lipscomb, Milwaukee County Board of Supervisors  
Mr. Chad Heimerl, WDNR  
Ms. Andrea Stern, WDNR  
Ms. Tanya Lourigan, WDNR  
Mr. Christopher Olds, WDNR  
Mr. William Sturtevant, WDNR

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## SEWRPC Staff Memorandum

### MILWAUKEE RIVER HYDRAULIC ANALYSES FOR CITY OF GLENDALE

May 9, 2017

#### INTRODUCTION AND BACKGROUND

A December 14, 2016, City of Glendale resolution requested “the Southeastern Wisconsin Regional Planning Commission to order the re-evaluation of the hydraulic analyses for the Estabrook Dam initially done April 8 and April 25 of 2014.” An interagency meeting to identify the specific questions the City of Glendale wants answered in response to the City resolution was convened by the Southeastern Wisconsin Regional Planning Commission (SEWRPC), on January 11, 2017. At that meeting, the City of Glendale staff indicated the hydraulic analyses requested in the resolution are to address flooding concerns along the Milwaukee River upstream of the Estabrook dam, and that the City residents’ concerns included vegetative growth on the islands within the main channel of the Milwaukee River in Lincoln Park and other areas along the main channel and east oxbow that are now exposed due to the drawdown of the impoundment and the impact of debris, ice jams, and flooding conditions.

There was consensus at the January 11, 2017, meeting that the hydraulic analysis requested by the City of Glendale and to be completed by SEWRPC would include the following:

- Modeling the condition of dam-in-place, gates open, stoplogs-in-place
- Developing profiles for the 10-, 50-, 100-, and 500-year flood flows
- Incorporating United States Environmental Protection Agency (USEPA) Lincoln Park/Milwaukee River Channel Phase 2 post-project bathymetry
- Collecting additional survey information, where necessary, to represent the islands in the main channel at the upstream end of Lincoln Park and the east oxbow
- Field checking current vegetative conditions within Lincoln Park from Hampton Avenue to Villard Avenue extended
- Modifying the hydraulic model to represent 2017 conditions based on the above information
- Comparing the hydraulic profiles of the April 2014 model to those computed with the 2017 model

SEWRPC Staff Memorandum, *Hydraulic Analyses for Estabrook Dam Environmental Assessment*, April 8, 2014, revised April 25, 2014, was prepared at the request of the Milwaukee County Department of Parks, Recreation and Culture. Under the analysis, the effective Federal Emergency Management Agency (FEMA) flood insurance study (FIS) hydraulic model of the Milwaukee River was updated and used to evaluate the effects of various alternatives relative to the future status of the Estabrook dam. One of the updates made to the model, which is documented in

the April 25, 2014, Staff Memorandum, was to adjust roughness coefficients for areas where vegetation had become established since the drawdown of the impoundment was ordered in 2008.

## **REVIEW OF RIVER CONDITIONS OVER TIME IN THE VICINITY OF LINCOLN PARK**

Exhibits 1 through 5 are a series of orthophotographs of the Milwaukee River in the vicinity of Lincoln Park covering the years 2000 to 2015. The flow of the Milwaukee River depicted in each of the orthophotographs ranges from 400 to 600 cubic feet per second (cfs). The Milwaukee River long-term mean flow based on 100 years of record at U.S. Geological Survey continuous streamflow gage No. 04087000 at Estabrook Park is 451 cfs. Each of the orthophotos depicts the Milwaukee River at a time when the Estabrook dam impoundment was drawn down. Exhibits 1 and 2 are during the seasonal “winter” drawdown of the impoundment prior to the current drawdown of the impoundment ordered by the Wisconsin Department of Natural Resources (WDNR) for safety reasons, beginning in 2008.

The orthophotographs provide a visual comparison of the status of various islands and vegetation present in the main channel and the east and west oxbows under times of both relatively normal flow conditions and similar drawdown conditions. Exhibits 1 through 4 show that the extents of the islands in the main channel and extents of the exposed river banks in the main channel and both the east and west oxbows are reasonably consistent from 2000 to 2010. There is also a similar lack of established vegetation visible on these exposed areas. The post-project results of the USEPA Lincoln Park/Milwaukee River Channel Phase 1 (west oxbow) and Phase 2 (main channel) dredging are both evident on Exhibit 5. Exhibit 5, photographed in 2015, shows the comprehensive removal of previously exposed sediment river banks along the west oxbow. It also shows the significant removal of the previously exposed island within the main channel at the southern end of Lincoln Park and sections of previously exposed river banks and other smaller islands throughout the main channel in Lincoln Park. The exposed areas not dredged as part of either the Phase 1 or Phase 2 projects, mainly in the east oxbow and the northern end of the main channel in Lincoln Park, appear to be of similar extent as previously depicted in Exhibits 1 through 4. Exhibit 5 also shows the presence of new vegetation along the east oxbow in riverbank areas now exposed year round due to the drawdown. Vegetation is also present in a number of the remaining exposed areas in the main channel, including the eastern island within the main channel at the northern end of Lincoln Park.

## **SOURCES OF INFORMATION**

The following sources of information were used in developing the hydraulic analysis:

1. Bathymetric data from the USEPA Lincoln Park/Milwaukee River Channel Phase 2 project completed in 2015 to remediate contaminated sediment within the Milwaukee River Area of Concern (AOC).
2. March 2017 cross-sectional survey data of the islands in the main channel at the upstream end of Lincoln Park and the east oxbow as collected by the Milwaukee Metropolitan Sewerage District (MMSD).
3. Field observations and photographs within Lincoln Park made by SEWRPC staff on March 29, 2017.

## **SCOPE OF HYDRAULIC ANALYSIS**

The hydraulic analysis as performed by SEWRPC was for the purpose of estimating the change in water surface profiles of the Milwaukee River main stem upstream of the Estabrook dam based on 2017 channel conditions as compared to 2014 channel conditions during flood flows with annual probabilities of occurrence of 10-, 2-, 1- and 0.2-percent (recurrence intervals of 10, 50, 100, and 500 years). The entire reach of the River in Milwaukee County was modeled, but the focus of the analysis was on the reach extending from the dam upstream to Good Hope Road. In this reach the 10-percent-annual-probability flood flow is 8,790 cfs. The 2-percent-annual-probability flow

ranges from 12,550 to 12,900 cfs. The 1-percent-annual-probability flow ranges from 14,340 to 14,800 cfs. The 0.2-percent-annual-probability flow ranges from 18,240 to 18,810 cfs.

## **HYDRAULIC MODELING**

The hydraulic analysis of the Milwaukee River main stem was performed using the U.S. Army Corps of Engineers HEC-RAS river analysis system computer program. The hydraulic model of the River was developed by the SEWRPC staff under an ongoing floodplain mapping study being conducted for the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) Steering Committee and the MMSD. The hydraulic model which served as the starting point for the analysis is the existing condition model in the 2014 Estabrook dam EA analysis.

### **2014 Updated Condition**

Under flood flow conditions, the 2014 Estabrook dam EA existing condition model assumed the dam gates were fully opened and stoplogs were in place, similar to the current condition under the WDNR-ordered drawdown.

Since one of the main residents' concerns included the status of the island in the main channel at the north end of Lincoln Park, a new cross-section located at RM 8.194 was added to the model to more fully capture the effects of this island over time on the water surface profiles during flood flow conditions. To enable a direct comparison of any resultant changes, cross-section RM 8.194 was added to both the 2014 and 2017 condition models. In 2014 the USEPA Lincoln Park/Milwaukee River Channel Phase 2 project was designed but had not yet been implemented. Therefore, in the 2014 updated condition model, the channel geometry for this additional cross-section was based on the Phase 2 pre-project bathymetric survey information. This pre-project Phase 2 information was also the basis of the channel geometry for the other existing cross-sections in the main channel and east oxbow in the 2014 Estabrook dam EA existing condition model.

The addition of cross-section RM 8.194 as described above was the only modification made to the 2014 updated condition model.

### **2017 Condition**

The 2014 updated condition model served as the starting point for the 2017 condition model. The first step in the development of the 2017 condition model was to refine the model to reflect the post-project bathymetric data obtained under the USEPA Lincoln Park/Milwaukee River Channel Phase 2 project for the Milwaukee River Area of Concern. For the Phase 2 sediment removal project, which has now been implemented, as-built bathymetric information was available in targeted project areas ranging from the upstream side of Estabrook dam to the north end of the Milwaukee River main channel in Lincoln Park. The model was refined by modifying existing River channel cross sections in the hydraulic model to reflect as-built, post-project Phase 2 bathymetric conditions.

The model was also updated to reflect the March 2017 cross-sectional survey of the islands in the main channel at the upstream end of Lincoln Park and the east oxbow as provided by the MMSD. Existing River channel cross-sections located at RM 7.851, RM 7.876, RM 7.934, RM 8.003, RM 8.132, RM 8.141, RM 8.145, and RM 8.194 were modified to reflect the 2017 survey data. Those cross section locations, with pre-Phase 2 project bathymetry, with the exception of RM 8.194, have always been included in the 2014 model, and they were retained for the analysis described here.

Based on field observations made by SEWRPC staff on March 29, 2017, limited adjustments of Manning's roughness coefficients were made in the reach of the River within Lincoln Park between W. Hampton Avenue and Villard Avenue extended. Manning's roughness coefficients were increased at modeled cross-sections RM 8.141 and RM 8.145 in the location of the eastern island within the main channel at the northern end of Lincoln Park to reflect vegetation which has become established since 2014. The roughness coefficients were changed from 0.035 to 0.04, which is consistent with the coefficient used for the adjacent "permanent" island immediately to the west.

Manning's roughness coefficients were decreased at modeled cross-sections RM 7.851, RM 7.876, and RM 7.934 in the location of the main channel at the southern end of Lincoln Park to reflect the removal of a vegetated island and river bank associated with the Phase 2 sediment removal project implemented in 2015. The roughness coefficients were changed from 0.04 to either 0.03 or 0.035, to make them consistent with coefficients used for the adjacent streambed locations.

## COMPARISON OF RESULTS OF HYDRAULIC ANALYSES

Table 1 sets forth the results of the flood flow profile computations for the conditions analyzed under the 10-, 2-, 1- and 0.2-percent-annual-probability floods. The water surface elevations under the 2017 condition are compared to the corresponding elevations under the 2014 updated condition model as described above. For the purposes of the comparisons described herein, the lower reach is defined as the reach between Estabrook dam and W. Hampton Avenue, the middle reach is defined as the reach between W. Hampton Avenue and the abandoned railroad bridge upstream of Lincoln Park, and the upper reach is defined as the reach between the abandoned railroad bridge upstream of Lincoln Park and Good Hope Road.

The 2017 condition model indicates a "potential" increase in water surface elevations of 0.01 foot immediately upstream of the dam for the 10-, 2-, 1-, and 0.2-percent-probability flood flow conditions relative to the 2014 updated condition.<sup>1</sup> However, beginning approximately 600 feet upstream of the dam and continuing upstream, the 2017 condition model results in either a decrease or no change in water surface elevations for the 10-, 2-, 1-, and 0.2-percent-probability flood flow conditions relative to the 2014 updated condition. The decreases gradually lessen upstream of the modified cross-sections (RM 8.194 being the furthest upstream modified cross-section) with the decrease limited to 0.01 foot at a few cross-section locations upstream of Bender Road and no change at any location upstream of Good Hope Road.

Under 1-percent-probability flood flow conditions, the 2017 condition water surface elevation in the lower reach was estimated to range from an increase of 0.01 foot to a decrease of 0.06 foot as compared to 2014 updated conditions. The 1-percent-probability elevation in the middle reach was estimated to decrease between 0.02 and 0.06 foot, and the 1-percent-probability elevation in the upper reach was estimated to decrease by up to 0.05 foot.

\* \* \*

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<sup>1</sup>The 0.01 foot increase is referred to as potential since the overall flat (non-increasing) flood profiles just upstream of the dam indicate the water surface elevations in this reach are controlled by the dam structure itself and the relatively wide and deep channel and are not generally impacted by small changes in channel geometry. The flood profiles are essentially flat through RM 6.963 and upstream of that location they begin to slope, indicating the water surface profile is controlled by channel and overbank characteristics. The only changes reflected in the 2017 model in the lower reach just upstream of the dam are the incorporation of the as-built post-project USEPA Phase 2 survey data, which results in a relatively small increase in the river channel cross sectional area and a small decrease in the flow velocity. The results are reported as a 0.01 foot increase due to the nature of the computational rounding within the computer program.

**Exhibit 1**

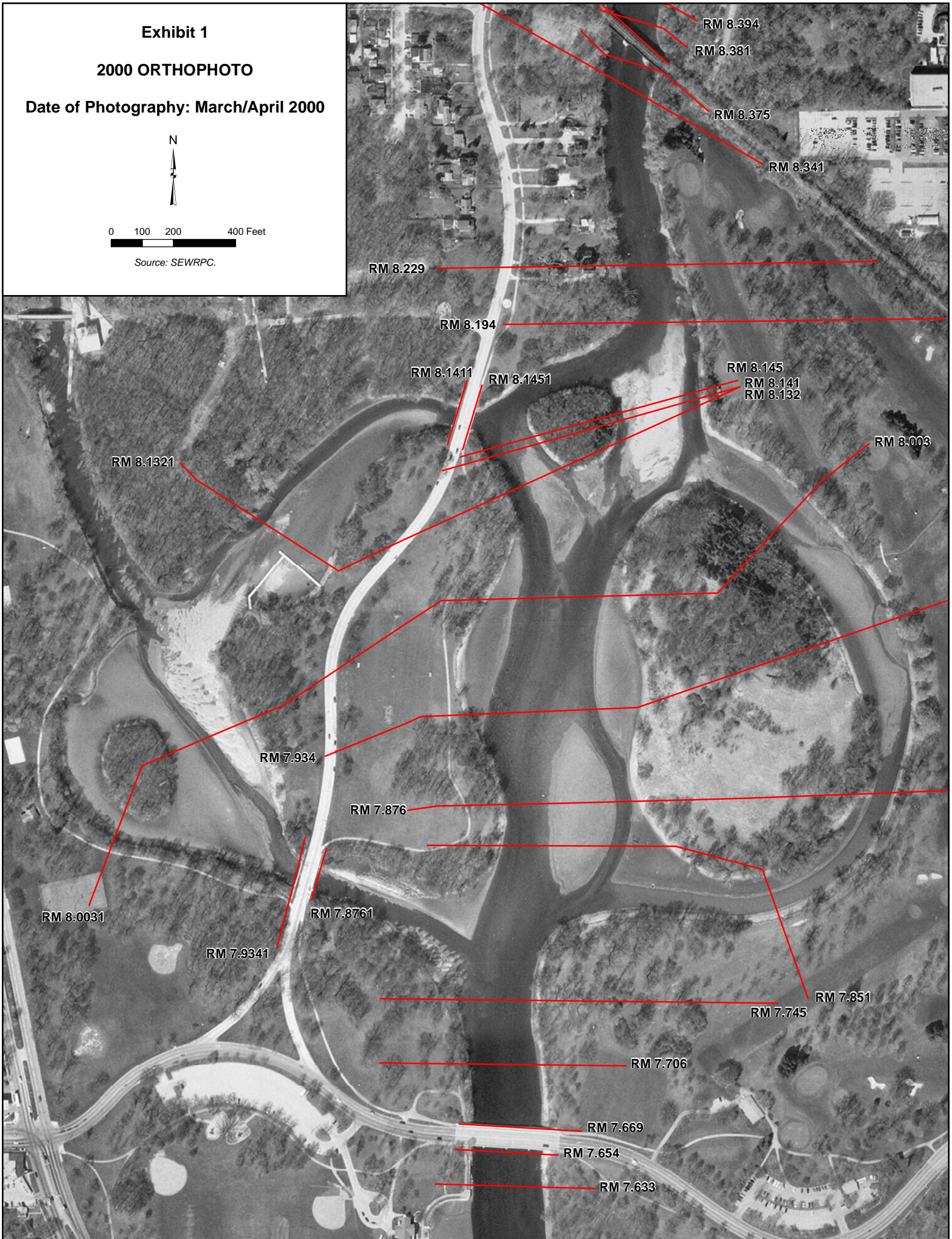
**2000 ORTHOPHOTO**

**Date of Photography: March/April 2000**



0 100 200 400 Feet

Source: SEWRPC.



**Exhibit 2**

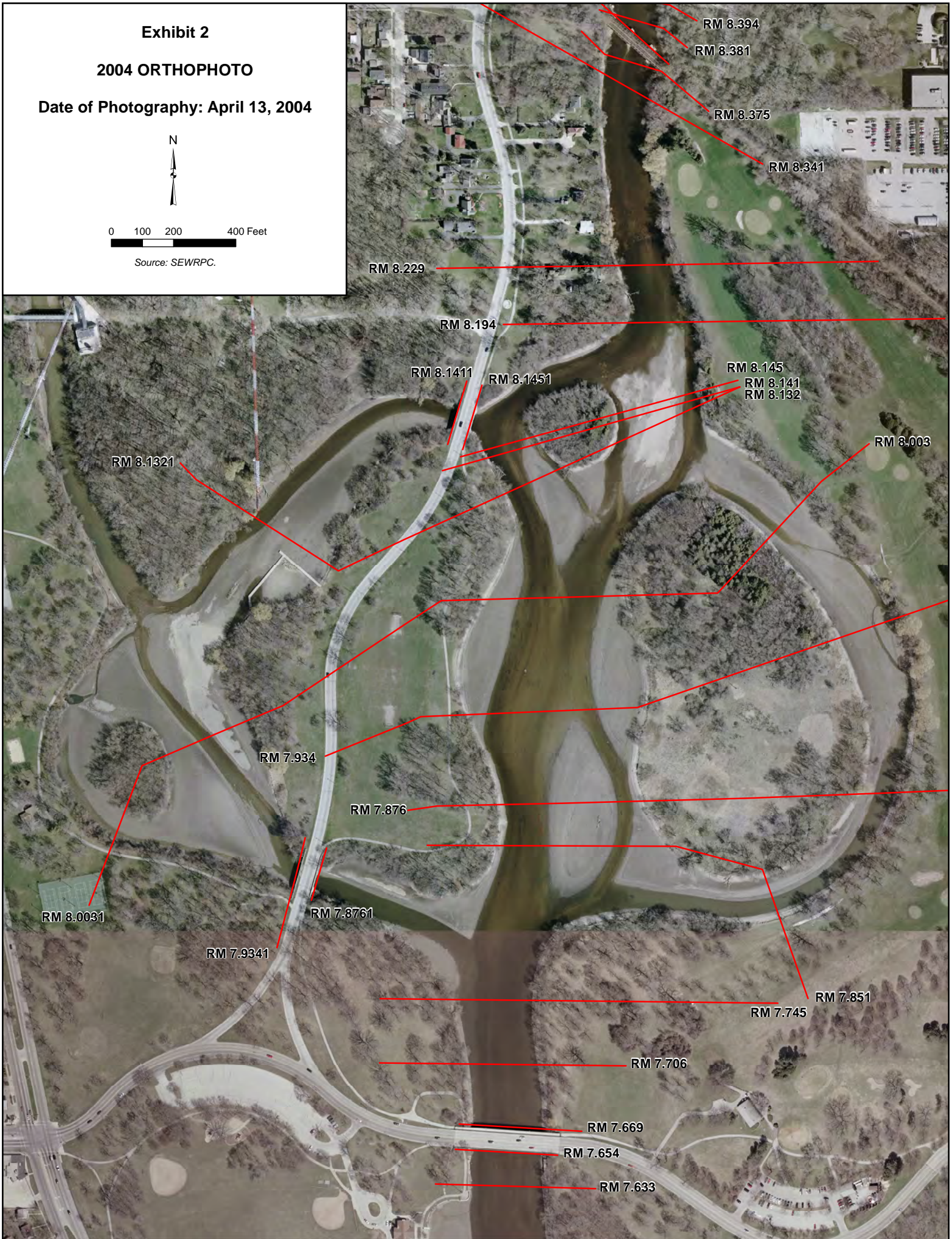
**2004 ORTHOPHOTO**

**Date of Photography: April 13, 2004**



0 100 200 400 Feet

Source: SEWRPC.



**Exhibit 3**

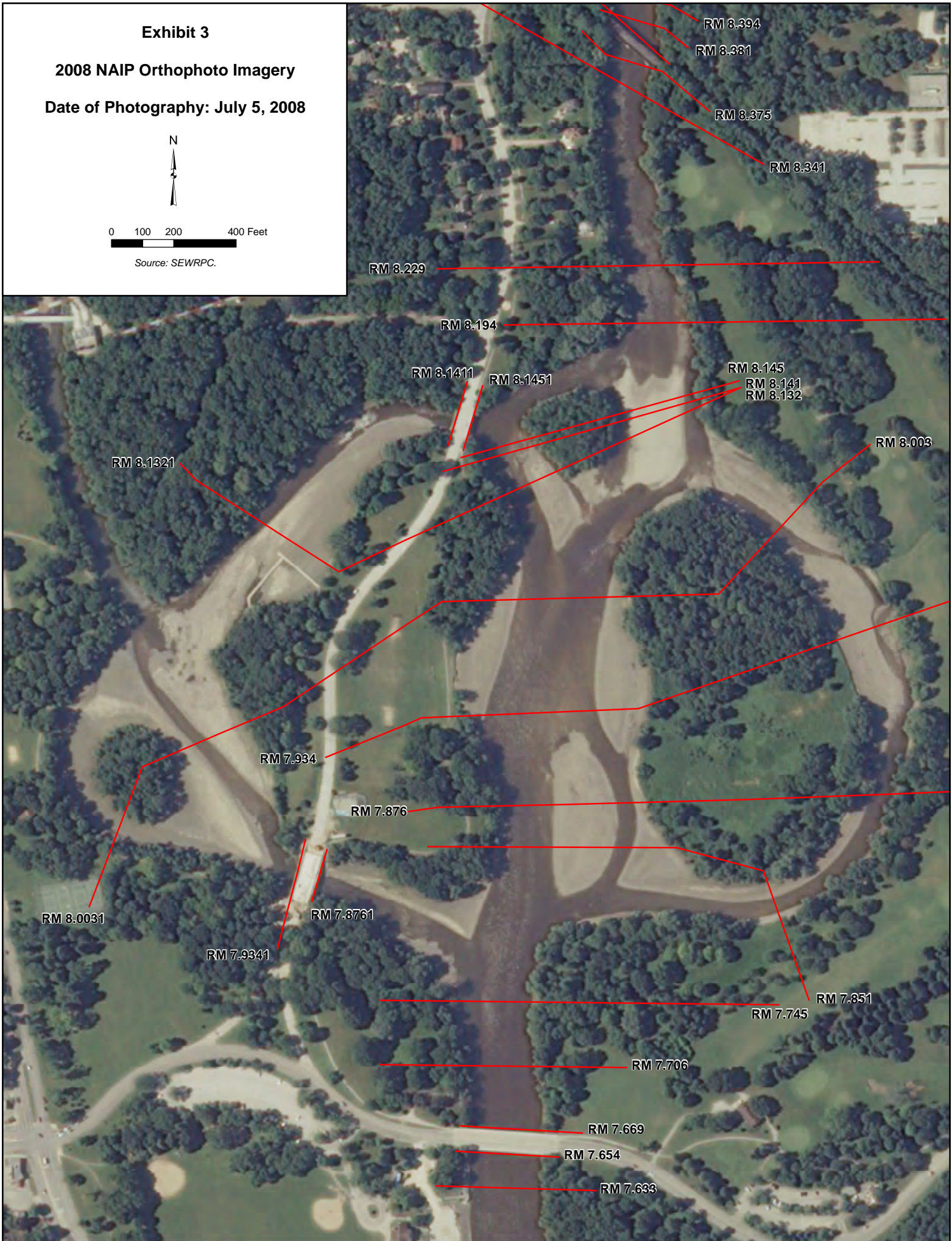
**2008 NAIP Orthophoto Imagery**

**Date of Photography: July 5, 2008**



0 100 200 400 Feet

Source: SEWRPC.





**Exhibit 4**

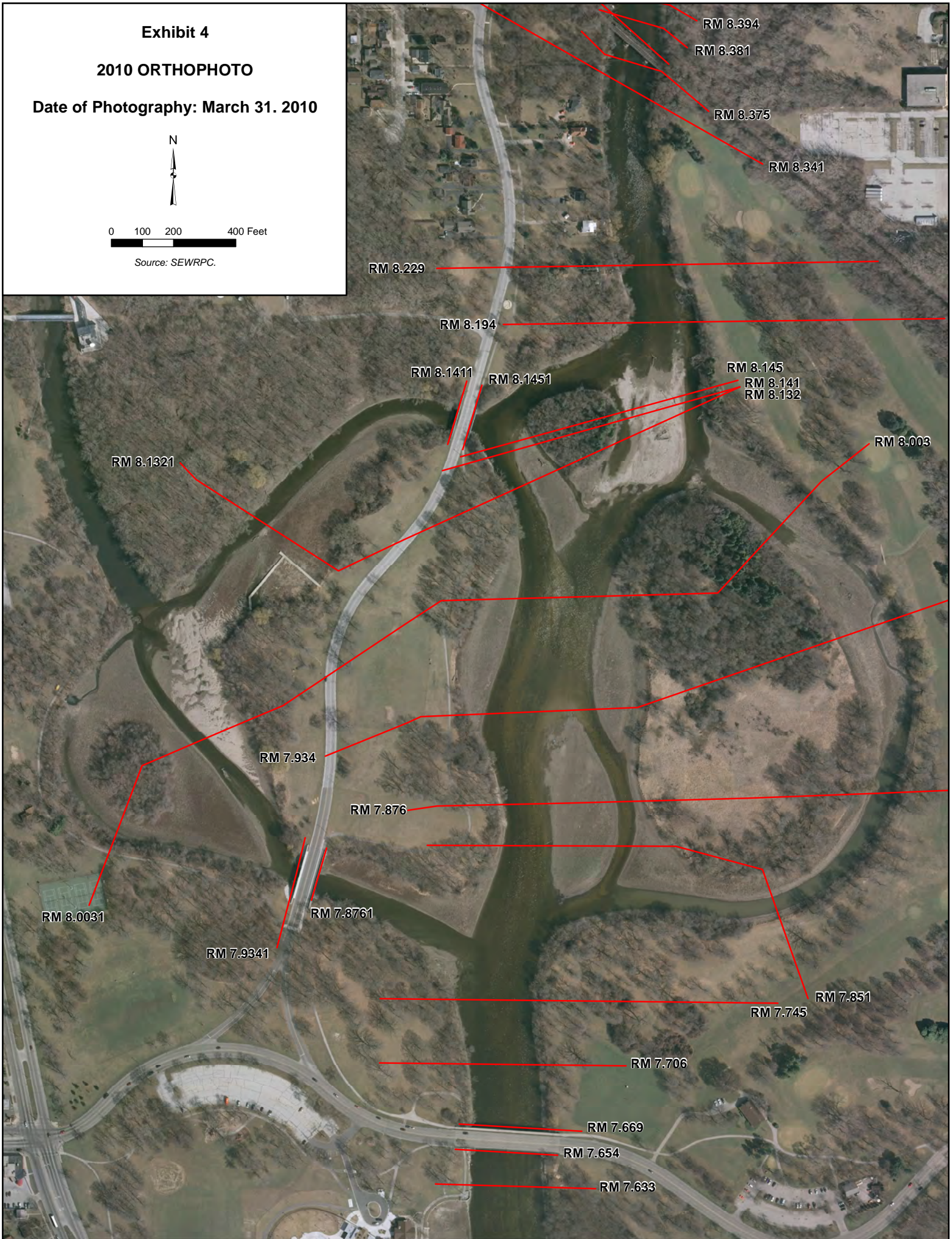
**2010 ORTHOPHOTO**

**Date of Photography: March 31, 2010**



0 100 200 400 Feet

Source: SEWRPC.



**Exhibit 5**

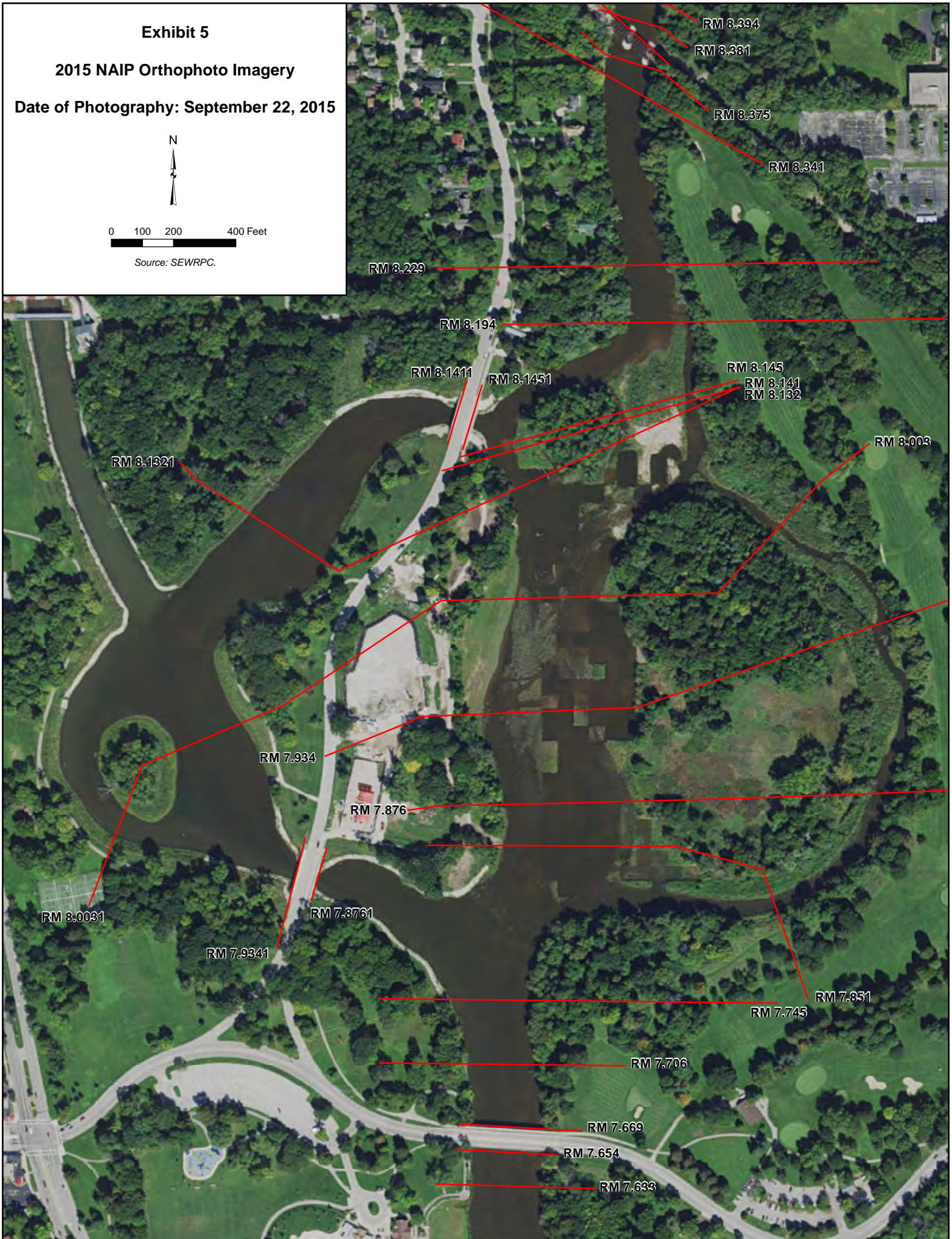
**2015 NAIP Orthophoto Imagery**

**Date of Photography: September 22, 2015**



0 100 200 400 Feet

Source: SEWRPC.



**Table 1**  
**Milwaukee River Water Surface Profile Comparison of 2014 Updated Conditions to 2017 Conditions Assuming Estabrook Dam Gates are Open and Stoplogs are in Place**

Model Reach	River Mile	Description	500-Yr Flow				100-Yr Flow				50-Yr Flow				10-Yr Flow			
			2014 EA Profile (NGVD29, ft)	2014 Updated Profile <sup>a</sup> (NGVD29, ft)	2017 Profile (NGVD29, ft)	Difference (ft)	2014 EA Profile (NGVD29, ft)	2014 Updated Profile <sup>a</sup> (NGVD29, ft)	2017 Profile (NGVD29, ft)	Difference (ft)	2014 EA Profile (NGVD29, ft)	2014 Updated Profile <sup>a</sup> (NGVD29, ft)	2017 Profile (NGVD29, ft)	Difference (ft)	2014 EA Profile (NGVD29, ft)	2014 Updated Profile <sup>a</sup> (NGVD29, ft)	2017 Profile (NGVD29, ft)	Difference (ft)
Lower Reach	6.827	Cross-Section	621.11	621.11	621.11	0.00	619.23	619.23	619.23	0.00	618.29	618.29	618.29	0.00	616.12	616.12	616.12	0.00
	6.8275	Estabrook Park Dam																
	6.829	Cross-Section	622.18	622.18	622.18	0.00	620.68	620.68	620.68	0.00	620.05	620.05	620.05	0.00	618.88	618.88	618.88	0.00
	6.843	Cross-Section	622.18	622.18	622.19	0.01	620.67	620.67	620.68	0.01	620.04	620.04	620.05	0.01	618.87	618.87	618.88	0.01
	6.928	Cross-Section	622.10	622.10	622.11	0.01	620.63	620.63	620.63	0.00	620.01	620.01	620.01	0.00	618.87	618.87	618.86	-0.01
	6.941	Cross-Section	622.14	622.14	622.13	-0.01	620.66	620.66	620.65	-0.01	620.05	620.05	620.03	-0.02	618.89	618.89	618.88	-0.01
	6.96	Cross-Section	622.16	622.16	622.16	0.00	620.69	620.69	620.68	-0.01	620.07	620.07	620.06	-0.01	618.90	618.90	618.90	0.00
	6.963	Cross-Section	622.17	622.17	622.17	0.00	620.70	620.70	620.69	-0.01	620.08	620.08	620.07	-0.01	618.91	618.91	618.90	-0.01
	6.987	Cross-Section	622.32	622.32	622.26	-0.06	620.82	620.82	620.76	-0.06	620.18	620.18	620.13	-0.05	618.97	618.97	618.94	-0.03
	7.087	Cross-Section	622.68	622.68	622.63	-0.05	621.15	621.15	621.10	-0.05	620.48	620.48	620.44	-0.04	619.18	619.18	619.15	-0.03
	7.103	Cross-Section	622.65	622.65	622.60	-0.05	621.13	621.13	621.08	-0.05	620.47	620.47	620.42	-0.05	619.17	619.17	619.15	-0.02
	7.11	Port Washington Road																
	7.117	Cross-Section	622.72	622.72	622.67	-0.05	621.19	621.19	621.14	-0.05	620.52	620.52	620.47	-0.05	619.21	619.21	619.18	-0.03
	7.16	Cross-Section	622.81	622.81	622.76	-0.05	621.28	621.28	621.23	-0.05	620.60	620.60	620.56	-0.04	619.27	619.27	619.24	-0.03
	7.17	IH 43																
	7.183	Cross-Section	622.95	622.95	622.91	-0.04	621.41	621.41	621.36	-0.05	620.72	620.72	620.68	-0.04	619.35	619.35	619.32	-0.03
	7.189	Cross-Section	622.99	622.99	622.94	-0.05	621.44	621.44	621.40	-0.04	620.75	620.75	620.71	-0.04	619.37	619.37	619.35	-0.02
	7.19	Ramp to IH 43																
	7.199	Cross-Section	623.11	623.11	623.06	-0.05	621.54	621.54	621.50	-0.04	620.84	620.84	620.80	-0.04	619.44	619.44	619.42	-0.02
	7.359	Cross-Section	623.44	623.44	623.40	-0.04	621.87	621.87	621.83	-0.04	621.15	621.15	621.12	-0.03	619.69	619.69	619.67	-0.02
	7.519	Cross-Section	623.91	623.91	623.88	-0.03	622.31	622.31	622.28	-0.03	621.57	621.57	621.54	-0.03	620.01	620.01	619.99	-0.02
	7.633	Cross-Section	624.07	624.07	624.03	-0.04	622.48	622.48	622.45	-0.03	621.74	621.74	621.71	-0.03	620.15	620.15	620.13	-0.02
	7.654	Cross-Section	624.09	624.09	624.05	-0.04	622.50	622.50	622.47	-0.03	621.76	621.76	621.73	-0.03	620.17	620.17	620.15	-0.02
7.66	Hampton Avenue																	
7.669	Cross-Section	624.26	624.26	624.22	-0.04	622.65	622.65	622.62	-0.03	621.89	621.89	621.86	-0.03	620.26	620.26	620.24	-0.02	
7.706	Cross-Section	624.50	624.50	624.48	-0.02	622.81	622.81	622.79	-0.02	622.02	622.02	622.00	-0.02	620.34	620.34	620.33	-0.01	
7.745	Cross-Section	624.66	624.66	624.63	-0.03	622.95	622.95	622.92	-0.03	622.14	622.14	622.12	-0.02	620.42	620.42	620.40	-0.02	
Right Split (west oxbow)	7.8761	Cross-Section	624.83	624.83	624.81	-0.02	623.09	623.09	623.07	-0.02	622.27	622.27	622.25	-0.02	620.49	620.49	620.49	0.00
	7.9	Milwaukee River Parkway																
	7.9341	Cross-Section	624.85	624.85	624.82	-0.03	623.11	623.11	623.09	-0.02	622.30	622.30	622.27	-0.03	620.52	620.52	620.51	-0.01
	8.0031	Cross-Section	624.92	624.92	624.88	-0.04	623.20	623.20	623.16	-0.04	622.38	622.38	622.33	-0.05	620.59	620.59	620.56	-0.03
	8.1321	Cross-Section	624.93	624.93	624.89	-0.04	623.20	623.20	623.16	-0.04	622.38	622.38	622.34	-0.04	620.60	620.60	620.56	-0.04
	8.1411	Cross-Section	624.90	624.90	624.87	-0.03	623.18	623.18	623.14	-0.04	622.36	622.36	622.32	-0.04	620.58	620.58	620.55	-0.03
	8.142	Milwaukee River Parkway																
8.1451	Cross-Section	624.91	624.91	624.87	-0.04	623.19	623.19	623.15	-0.04	622.37	622.37	622.33	-0.04	620.59	620.59	620.56	-0.03	
Middle Reach (main channel, east oxbow)	7.851	Cross-Section	624.86	624.86	624.83	-0.03	623.13	623.13	623.10	-0.03	622.30	622.30	622.28	-0.02	620.53	620.53	620.51	-0.02
	7.876	Cross-Section	624.87	624.87	624.83	-0.04	623.14	623.14	623.10	-0.04	622.32	622.32	622.28	-0.04	620.54	620.54	620.51	-0.03
	7.934	Cross-Section	624.90	624.90	624.86	-0.04	623.17	623.17	623.13	-0.04	622.35	622.35	622.31	-0.04	620.57	620.57	620.53	-0.04
	8.003	Cross-Section	624.90	624.90	624.85	-0.05	623.18	623.18	623.13	-0.05	622.36	622.36	622.31	-0.05	620.58	620.58	620.54	-0.04
	8.132	Cross-Section	624.94	624.94	624.89	-0.05	623.22	623.22	623.16	-0.06	622.40	622.40	622.34	-0.06	620.62	620.62	620.57	-0.05
	8.141	Cross-Section	624.94	624.94	624.88	-0.06	623.22	623.22	623.16	-0.06	622.40	622.40	622.34	-0.06	620.62	620.62	620.56	-0.06
8.145	Cross-Section	624.94	624.94	624.88	-0.06	623.22	623.22	623.16	-0.06	622.41	622.41	622.34	-0.07	620.63	620.63	620.57	-0.06	
Upper Reach	8.194	Cross-Section	624.80	624.80	624.75	-0.05	623.10	623.10	623.05	-0.05	622.30	622.30	622.25	-0.05	620.56	620.56	620.51	-0.05
	8.229	Cross-Section	624.68	624.70	624.65	-0.05	623.02	623.05	622.99	-0.06	622.24	622.26	622.21	-0.05	620.54	620.55	620.50	-0.05
	8.341	Cross-Section	624.90	624.92	624.87	-0.05	623.26	623.29	623.23	-0.06	622.48	622.50	622.45	-0.05	620.76	620.78	620.73	-0.05
	8.357	Cross-Section	624.84	624.87	624.81	-0.06	623.23	623.25	623.20	-0.05	622.45	622.48	622.42	-0.06	620.75	620.77	620.72	-0.05
	8.36	Railroad Bridge																
	8.375	Cross-Section	625.20	625.22	625.17	-0.05	623.51	623.54	623.49	-0.05	622.71	622.73	622.68	-0.05	620.94	620.96	620.91	-0.05
	8.381	Cross-Section	625.21	625.24	625.19	-0.05	623.53	623.56	623.51	-0.05	622.73	622.75	622.70	-0.05	620.96	620.97	620.93	-0.04
	8.394	Cross-Section	625.40	625.42	625.37	-0.05	623.66	623.68	623.63	-0.05	622.82	622.84	622.79	-0.05	621.00	621.02	620.98	-0.04
	8.579	Cross-Section	626.27	626.29	626.25	-0.04	624.47	624.49	624.45	-0.04	623.60	623.62	623.58	-0.04	621.67	621.68	621.65	-0.03
	8.66	Cross-Section	626.73	626.74	626.71	-0.03	624.88	624.90	624.86	-0.04	623.99	624.00	623.97	-0.03	621.98	622.00	621.96	-0.04

8.716	Cross-Section	626.90	626.91	626.88	-0.03	625.06	625.07	625.04	-0.03	624.16	624.18	624.15	-0.03	622.16	622.17	622.14	-0.03
8.73	Cross-Section	626.88	626.90	626.86	-0.04	625.05	625.06	625.03	-0.03	624.16	624.17	624.14	-0.03	622.15	622.16	622.13	-0.03
8.74	Silver Spring Road																
8.759	Cross-Section	627.07	627.09	627.06	-0.03	625.22	625.24	625.21	-0.03	624.33	624.34	624.31	-0.03	622.32	622.33	622.30	-0.03
8.783	Cross-Section	627.14	627.15	627.12	-0.03	625.29	625.30	625.27	-0.03	624.39	624.41	624.38	-0.03	622.39	622.40	622.38	-0.02
8.963	Cross-Section	627.70	627.72	627.69	-0.03	625.87	625.88	625.85	-0.03	624.97	624.98	624.96	-0.02	622.93	622.94	622.92	-0.02
9.125	Cross-Section	628.28	628.29	628.26	-0.03	626.45	626.46	626.44	-0.02	625.55	625.56	625.54	-0.02	623.49	623.50	623.48	-0.02
9.427	Cross-Section	629.79	629.80	629.79	-0.01	627.92	627.93	627.91	-0.02	627.00	627.01	626.99	-0.02	624.86	624.86	624.85	-0.01
9.669	Cross-Section	630.59	630.59	630.58	-0.01	628.74	628.74	628.73	-0.01	627.82	627.82	627.81	-0.01	625.68	625.69	625.68	-0.01
9.846	Cross-Section	631.40	631.40	631.39	-0.01	629.80	629.80	629.79	-0.01	629.04	629.04	629.04	0.00	627.14	627.14	627.14	0.00
10.009	Cross-Section	632.67	632.67	632.67	0.00	631.11	631.11	631.11	0.00	630.31	630.31	630.31	0.00	628.20	628.20	628.20	0.00
10.023	Cross-Section	632.85	632.86	632.85	-0.01	631.26	631.26	631.26	0.00	630.44	630.45	630.44	-0.01	628.30	628.30	628.30	0.00
10.04	Bender Road																
10.051	Cross-Section	632.80	632.80	632.80	0.00	631.21	631.21	631.20	-0.01	630.40	630.40	630.39	-0.01	628.26	628.26	628.26	0.00
10.192	Cross-Section	634.13	634.13	634.12	-0.01	632.31	632.32	632.31	-0.01	631.40	631.40	631.40	0.00	629.10	629.10	629.10	0.00
10.212	Cross-Section	634.25	634.25	634.24	-0.01	632.41	632.41	632.41	0.00	631.48	631.48	631.48	0.00	629.15	629.15	629.15	0.00
10.22	Railroad Bridge																
10.226	Cross-Section	634.58	634.58	634.58	0.00	632.70	632.70	632.70	0.00	631.76	631.76	631.76	0.00	629.41	629.41	629.41	0.00
10.231	Cross-Section	634.59	634.59	634.59	0.00	632.72	632.72	632.71	-0.01	631.77	631.77	631.77	0.00	629.43	629.43	629.43	0.00
10.26	Cross-Section	634.71	634.71	634.71	0.00	632.83	632.83	632.83	0.00	631.88	631.88	631.88	0.00	629.54	629.54	629.54	0.00
10.326	Cross-Section	634.98	634.98	634.98	0.00	633.08	633.08	633.08	0.00	632.12	632.12	632.12	0.00	629.76	629.76	629.75	-0.01
10.34	Kletsch Park Dam																
10.351	Cross-Section	635.01	635.01	635.01	0.00	633.15	633.15	633.15	0.00	632.25	632.25	632.25	0.00	630.46	630.46	630.46	0.00
10.489	Cross-Section	635.26	635.26	635.26	0.00	633.42	633.42	633.42	0.00	632.53	632.53	632.53	0.00	630.75	630.75	630.75	0.00
10.937	Cross-Section	636.06	636.06	636.06	0.00	634.23	634.23	634.23	0.00	633.34	633.34	633.34	0.00	631.51	631.51	631.51	0.00
11.228	Cross-Section	636.25	636.25	636.25	0.00	634.46	634.46	634.46	0.00	633.59	633.59	633.59	0.00	631.81	631.81	631.81	0.00
11.488	Cross-Section	636.65	636.65	636.65	0.00	635.26	635.26	635.26	0.00	634.64	634.64	634.64	0.00	633.26	633.26	633.26	0.00
11.524	Cross-Section	636.80	636.80	636.80	0.00	635.47	635.47	635.47	0.00	634.86	634.86	634.86	0.00	633.50	633.50	633.50	0.00
11.53	Green Tree Road																
11.537	Cross-Section	637.82	637.83	637.82	-0.01	636.36	636.36	636.36	0.00	635.69	635.69	635.69	0.00	634.16	634.16	634.16	0.00
11.55	Cross-Section	637.96	637.96	637.96	0.00	636.49	636.49	636.49	0.00	635.81	635.81	635.81	0.00	634.26	634.26	634.26	0.00
11.573	Cross-Section	638.06	638.06	638.06	0.00	636.60	636.60	636.60	0.00	635.92	635.92	635.92	0.00	634.38	634.38	634.38	0.00
11.795	Cross-Section	640.21	640.21	640.21	0.00	638.52	638.52	638.52	0.00	637.69	637.69	637.69	0.00	635.80	635.80	635.80	0.00
11.919	Cross-Section	640.71	640.71	640.71	0.00	639.01	639.01	639.01	0.00	638.18	638.18	638.18	0.00	636.30	636.30	636.30	0.00
11.923	Cross-Section	640.90	640.90	640.90	0.00	639.20	639.20	639.20	0.00	638.37	638.37	638.37	0.00	636.47	636.47	636.47	0.00
11.94	Good Hope Road																
11.955	Cross-Section	641.41	641.41	641.41	0.00	639.60	639.60	639.60	0.00	638.75	638.75	638.75	0.00	636.85	636.85	636.85	0.00

Decreases in water surface elevation relative to 2014 profile.  
Increases in water surface elevation relative to 2014 profile.

<sup>o</sup> 2014 condition updated by adding cross-section RM 8.194