CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: 4/25/2019

TO: Xiaochun, Zhang - Madison

FROM: Shaun Shields

SUBJECT: Applicable Water Quality Criteria for the Kewaunee Marsh Arsenic Spill Site

This is in response to your request for water quality based effluent limits for the diffuse surface water discharge of Arsenic from contaminated sediment and soil from the Kewaunee Marsh Arsenic Spill Site to the Kewaunee River. The following evaluation assesses the applicable criteria for the surface waters affected by the Kewaunee Marsh Arsenic Spill Site.

The Kewaunee Marsh Arsenic Spill Site is located in a wetland which drains or discharges to the Kewaunee River and subsequently Lake Michigan. The discharge of arsenic from this site should be managed in a way such that the designated uses of all three waters of the state are protected through eventual compliance with water quality criteria developed for each water body. The applicable water quality criteria for total recoverable arsenic are detailed in the table below:

Criteria (µg/L)	Kewaunee Marsh Limited Aquatic Life	Kewaunee River Warm Water Sport Fishery	Lake Michigan Cold Water Public Water Supply
Acute Toxicity	340	340	340
Chronic Toxicity	152	152	148
Human Cancer	40	13.3	0.2

One of the objectives of this evaluation is to identify or delineate at which points the applicable surface water criteria should be achieved to maintain water quality standards. The exact locations are not detailed in this evaluation, however potential areas in which monitoring can be used to confirm if designated criteria are met are identified.

As arsenic is dispersed throughout the Kewaunee Marsh, delineating a mixing zone within the wetland is technically infeasible. Instead, it is advised that the acute toxicity, chronic toxicity, and human cancer criteria are standards applicable to the whole of the standing water in the marsh. Standing water in the marsh may refer to areas of the wetland that are only periodically inundated with water and areas of the marsh which standing water is consistently present. Remedial action to protect the designated water quality standards in the Kewaunee Marsh should not exceed 40 µg/L arsenic in the standing water of the Kewaunee Marsh. If the standing water meets the human cancer criteria of 40 µg/L, protection of aquatic life from acute and chronic toxicity can be accomplished.

The human cancer criteria applicable to the Kewaunee River is to be met at every point outside of the mixing zone in accordance to NR 102.05(3). While NR 102.03(2) defines a mixing zone, delineation of an acceptable mixing zone requires additional field work and modeling. Instead, as acute and chronic toxicity criteria are to be met in the Kewaunee Marsh, the mixing zone delineation only affects where any exceedances of the Kewaunee River Human Cancer Criteria of 13.3 µg/L is allowable. In practice, if arsenic concentrations in the Kewaunee River downstream of the initial mixing zone are below 13.3 µg/L, compliance with the human cancer criteria can be established. It is possible that monitoring downstream

of the Ahnapee trail crossing near the river bend may be a suitable monitoring site to determine compliance with the Kewaunee River human cancer criteria, however field investigations should confirm the mixing zone delineation prior to assessing compliance. Based on previous surface water monitoring, the human health criteria of 13.3 µg/L is exceeded in the Kewaunee River in samples taken adjacent to the wetland, but downstream samples indicate levels of arsenic below 13.3 µg/L. Furthermore, compliance with Lake Michigan human cancer criteria will infer compliance with the Kewaunee River human cancer criteria. Therefore, it is likely that efforts taken to achieve compliance with the Lake Michigan human cancer criteria of 0.2 µg/L will provide adequate protection in achieving arsenic concentrations below the human cancer criteria of 13.3 µg/L applicable to the Kewaunee River.

When considering arsenic discharge from the Kewaunee Marsh, downstreams impacts for Lake Michigan must also be considered. Recent monitoring data from surface water intakes in Lake Michigan indicate ambient total recoverable Arsenic concentrations in Lake Michigan of approximately 0.9 µg/L. This level is currently in exceedance of levels protective of Lake Michigan's classification as a cold water public water supply. Since ambient arsenic concentrations in Lake Michigan exceed 0.2 µg/L, any discharge of Arsenic should be managed in such a way that it does not contribute to an exceedance of the human cancer criteria in Lake Michigan. In practice, this concludes that an arsenic limit of 0.2 µg/L is applicable to the Kewaunee River and compliance with the limit should be achieved at the river mouth before the confluence with Lake Michigan.

It is likely that the most stringent water quality criteria applicable to the arsenic discharge from the Kewaunee Marsh is the Lake Michigan Cold Water – Public Water Supply Human Cancer Criteria of 0.2 µg/L. While dilution of the arsenic discharge from the Kewaunee Marsh with the Kewaunee River is allowed to meet the 0.2 µg/L criteria, there is uncertainty as to the amount of dilution available. Previous surface monitoring upstream of the spill site indicated non-detectable levels of arsenic in the Kewaunee River, however the limit of detection (LOD) for previous monitoring results exceeded 1.0 µg/L, and are therefore unable to adequately determine if ambient arsenic concentrations in the Kewaunee River exceed 0.2 µg/L. It should be noted that several past monitoring efforts indicate several rivers in Wisconsin currently exceed arsenic levels of 0.2 µg/L and downstream monitoring in the Kewaunee River showed arsenic levels at 1.2 µg/L. Limited monitoring data indicates that the discharge from the Kewaunee Marsh Arsenic Spill Site may be contributing to the exceedance in the human cancer criteria of 0.2 µg/L applicable in Lake Michigan.

Conclusions and Recommendations:

Three sets of arsenic water quality criteria are applicable to this site, however for the protection of all three waterbodies, the two following objectives and limits are recommended.

1. Remedial actions shall be taken to minimize arsenic concentrations in the standing water in the Kewaunee Marsh arsenic spill site below 40 µg/L.
2. Remedial actions shall be taken to minimize the discharge of arsenic from the Kewaunee Marsh arsenic spill site that may contribute or result in concentrations of arsenic in the Kewaunee River near the confluence with Lake Michigan at levels above 0.2 µg/L. Adaptive management may be acceptable to implement technology based remedial options at present time with post remediation surface water quality monitoring near the river mouth.

This evaluation does not consider the Public Heath Groundwater Quality Standards in ch. NR 140.

If there are any questions or comments, please contact Shaun Shields at (920) 662-5103 or Shaun.Shields@wisconsin.gov or Diane Figiel at (608) 264-6274 or Diane.Figiel@wisconsin.gov.

ATTACHMENTS (2): Background Monitoring Data, Maps of Monitoring Data and Treatment Area

E-cc: Rachel Fritz, Water Resources Engineer – Madison
Diane Figiel, Water Resources Engineer – WY/3

Attachment #1: Background Monitoring Data

Upstream Sites			
Sample ID	Date	Arsenic (µg/L)	Description
KMWT-01	6/18/1997	<1*	North of site
BACK01-01	7/26/2001	Non-detect*	First upstream bend of river
Kewaunee River Monitoring Sites			
Sample ID	Date	Arsenic (µg/L)	Description
R-2	1/30/95	4.1	NE of site
SW-9	10/26/12	<5	Near mouth of minor slough
SW-11	4/23/13	5.25	near mouth of large slough NE of site
R-1	1/30/95	<1	North center of rail trail bridge
	3/14/95	<1	
	3/20/95	<1	
	3/27/95	<1	
	4/3/95	2.7	
	4/10/95	<1	
sts-R[a]	4/23/96	118	West side river, downstream of rail trail
	5/20/96	108	
	6/18/96[b]	50	
	7/12/96	3.7	
	10/23/96	3.2	
ss-R4	6/18/96	<16	Unknown - river channel downstream of rail trail
sw-04	5/21/96	2.4[c]	River bank, downstream of rail trail bridge
KMWT-06	6/18-19/97	1.0[c]	South of rail trail bridge
KM01-west bridge	7/26/01	1.2*	West end of rail trail bridge
KM01 - center bridge	7/26/01	Non-detect[c]	Center of rail trail bridge
SW-6	10/24/12	<5.0[c]	River at rail trail bridge
	4/23/13	<5.0[c]	
SW16-12	6/29/16	<16	Near MW04-12
SW17-2	5/3/17	16	Near MW04-12
SW17-1	5/3/2017	9.95	Near s. slough mouth
Downstream			
Sample ID	Date	Arsenic (µg/L)	Description
R-3	1/30/1995	1.2	At HWY 42 Bridge Near Confluence with Lake Michigan

a. Elevated concentrations may be result of site disturbance of putting woodchips on in the treatment area
b. Paired total recoverable and Arsenic test. Dissolved arsenic below LOD (16 µg/L)
c. Dissolved arsenic tested

Attachment #2: Map of Surface Water Monitoring Sites

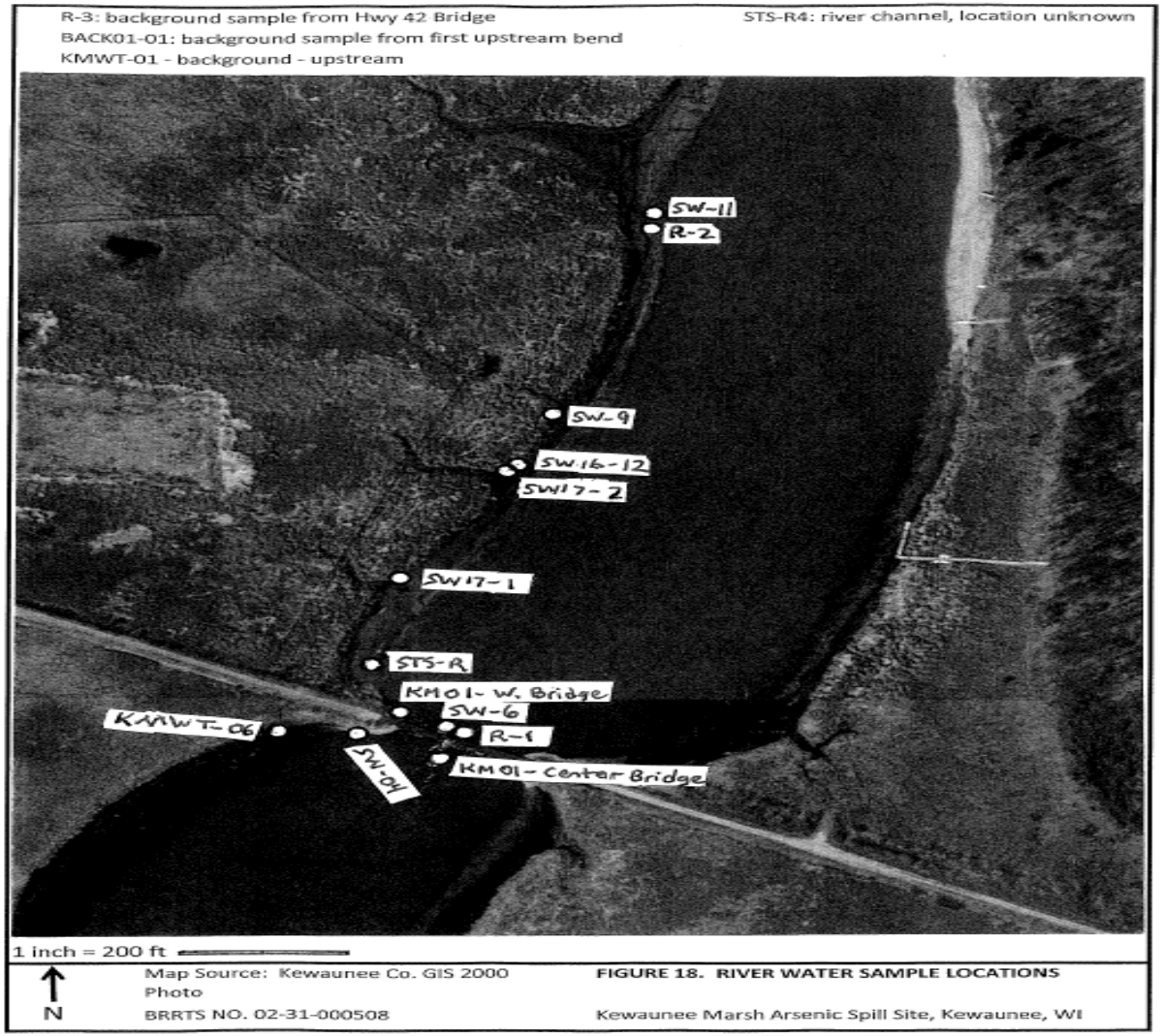
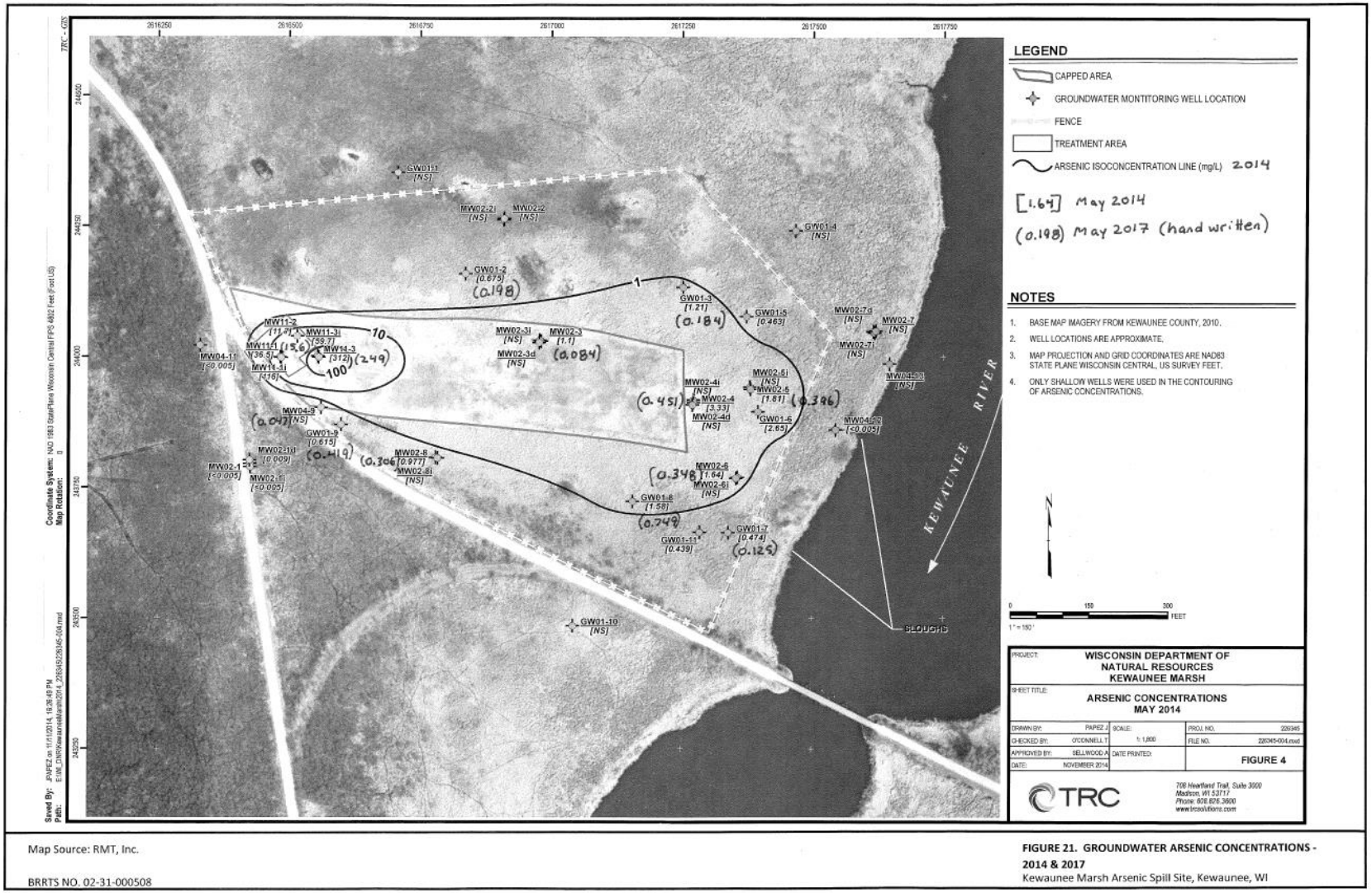


FIGURE 18. RIVER WATER SAMPLE LOCATIONS

Kewaunee Marsh Arsenic Spill Site, Kewaunee, WI

Attachment #2: Map of Treatment Area



Map Source: RMT, Inc.

BRRTS NO. 02-31-000508

FIGURE 21. GROUNDWATER ARSENIC CONCENTRATIONS - 2014 & 2017
Kewaunee Marsh Arsenic Spill Site, Kewaunee, WI