
Name of Organization: Wisconsin Department of Natural Resources

Type of Organization: State

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Project Title: Kewaunee Marsh Arsenic Remediation

Project Category: Contaminated Sediments

Rank by Organization (if applicable): 5

Total Funding Requested (\$): 150,000 **Project Duration:** 2 Years

Abstract:

In August of 1993, the Wisconsin Department of Natural Resources (WDNR) became aware of wetland areas either devoid of vegetation or having stressed vegetation in a portion of the state-owned C.D. Besadny Fish and Wildlife Area. The site is located approximately 1,200 feet from the Kewaunee River and approximately 1 mile upstream of the mouth of Kewaunee River at Lake Michigan. The unvegetated area is believed to be the result of a railcar derailment and resulting spill of powder/granular arsenic compound in the early 1940's. Arsenic was commonly used in the period for applications as a herbicide and pesticide. While there is no way to determine the size of the spill that occurred, however anecdotal evidence suggests the spill was quite large.

When the site was discovered an area (approximately 200 x 400 feet) of unvegetated soil was noted within the large wetland complex. Later a number of goose and waterfowl carcasses were discovered in the unvegetated area that were assumed casualties related to the arsenic contamination. Initial investigations revealed high levels of arsenic in soil (up to 68,000 mg/kg) and the likelihood that dead areas in the marsh were related to these arsenic levels. As an interim measure to reduce direct contact threat, in 1996 a cap of composted wood chips and yard waste was placed over four acres of wetland containing the unvegetated area and most heavily contaminated soils. In addition a fifteen acre area surrounding the capped area where soil significantly contaminated with arsenic was present was fenced to prevent direct contact. However the full degree of impact to groundwater and surface water adjacent to the spill area has not been fully determined. It is necessary to determine the current and future impacts the site is having, and will have, on biota that rely on the marsh and river for habitat, as well as evaluate an array of appropriate permanent remedial alternatives.

Geographic Areas Affected by the Project

States:

- | | | |
|------------------------------------|-------------------------------------|--------------|
| <input type="checkbox"/> Illinois | <input type="checkbox"/> | New York |
| <input type="checkbox"/> Indiana | <input type="checkbox"/> | Pennsylvania |
| <input type="checkbox"/> Michigan | <input checked="" type="checkbox"/> | Wisconsin |
| <input type="checkbox"/> Minnesota | <input type="checkbox"/> | Ohio |

Lakes:

- | | | |
|--|--------------------------|-----------|
| <input type="checkbox"/> Superior | <input type="checkbox"/> | Erie |
| <input type="checkbox"/> Huron | <input type="checkbox"/> | Ontario |
| <input checked="" type="checkbox"/> Michigan | <input type="checkbox"/> | All Lakes |

Geographic Initiatives:

- | | | | | |
|--|----------------------------------|-------------------------------------|--------------------------------------|---|
| <input type="checkbox"/> Greater Chicago | <input type="checkbox"/> NE Ohio | <input type="checkbox"/> NW Indiana | <input type="checkbox"/> SE Michigan | <input type="checkbox"/> Lake St. Clair |
|--|----------------------------------|-------------------------------------|--------------------------------------|---|

Primary Affected Area of Concern: Not Applicable

Other Affected Areas of Concern: Kewaunee River/Lake Michigan at Kewaunee WI

For Habitat Projects Only:

Primary Affected Biodiversity Investment Area:

Other Affected Biodiversity Investment Areas:

Problem Statement:

The results of initial site investigation indicate that approximately 15 acres of the marsh soils, surface water, and groundwater contain elevated levels of arsenic with the highest levels associated with the dead and stressed areas of vegetation. Areas of contaminated soils (0 - 2 ft) where arsenic concentrations exceed 1,000 mg/kg occur over approximately 4 acres. In the most highly contaminated area, arsenic contamination extends to approximately 8 feet below the surface. Arsenic concentrations of 920 mg/L in the surface waters and 800 mg/L in the "pore water" were measured at the site.

Several site specific water quality standards were calculated and apply to groundwater discharge from the site to the Kewaunee River including: Acute Toxicity Criteria = 0.680 mg/l, Chronic Toxicity Criteria = 0.925 mg/l, and Human Cancer Criteria = 7.98 mg/l. Preliminary computer modeling of contaminant flow to the river shows groundwater with an arsenic concentration of 200 mg/l discharging from the site to the river in the future. However, critical elements of the original study such as mobility of the arsenic toward the River are disputed. The movement of the material, critical for understanding the impact on the River biota, could occur at a much greater rate than originally predicted. Additional modeling of the contaminated groundwater and its movement are necessary.

Initial studies of movement and bioaccumulation of arsenic in the food chain at the site indicate that it is indeed being picked up by aquatic vegetation and invertebrates, and being passed on to primary herbivores and carnivores. Arsenic has acute and chronic effects on fish, wildlife, invertebrates as well as plants and algae. However, "Bioconcentration factors (BCF) experimentally determined for arsenic in aquatic organisms are, except for algae, relatively low" (Biological Report 85[1.12], USDA Fish and Wildlife Service). The report goes on to say "toxic and other effects of arsenicals to aquatic life are significantly modified by numerous biological and abiotic factors. The LC-50 values, for example, are markedly affected by water temperature, pH, Eh, organic content, phosphate concentration, suspended solids, and presence of other substances and toxicants, as well as arsenic speciation, and duration of exposure".

Wiersma, J.H. Associate Professor of Chemistry, UWGB reports on January 18, 1989 that "Arsenicals are readily absorbed by ingestion but most of the arsenic is excreted in the urine within a few days to a week. This fairly rapid turn over suggests that long-term effects would most likely have to occur through repeated exposure to arsenic contamination". Wiersma continues in his January 18, 1989 report that "adverse effects on aquatic ecosystems have been reported at about 0.019 mg/L, a level that affected three species of marine algae. The lowest level showing an effect on animals (a narrow-mouthed toad) was 0.04 mg/L. Levels of arsenic in the 0.08 mg/L range have been shown to have an adverse effect on amphipods..... Arsenic can become

concentrated in a number of different species especially plants including algae". Further study of the effect the site is

having on the aquatic ecosystem must be conducted.

The cap placed over an area of the site was not intended to act as a long-term direct contact protection nor to reduce infiltration to the underlying contaminated soil, instead only as an interim measure to remove the direct contact threat the soil and surface water posed. The cap will quickly degrade and likely expose the arsenic contaminated soil at the surface once again. Prior to that occurring, permanent remedies that adequately address direct contact and contaminated groundwater flow to the river must be evaluated and the most feasible implemented at the site.

Proposed Work Outcome:

WDNR believes it is very likely that the interim action capping of the site will prove to be inadequate for complete environmental protection at the site, therefore, we propose to conduct additional data collection at the site to support a remediation alternative that will be protective of human health and the environment through time. The additional contaminant data would be combined with previous investigation results to determine the most feasible remedial alternative. The outcome of the study will include determination of 1) If and when a plume of contaminated groundwater will reach the Kewaunee River at levels above regulatory standards and/or levels that will negatively effect the aquatic ecosystem. This will be accomplished by establishing five sampling sites within the river including both upstream and downstream of the site with appropriate compounds monitored. In addition, a caged fish (or amphibian) study will be conducted at select locations to determine the amount of arsenic uptake in these organisms. 2) Whether the current cap is appropriately effective in reduction of downward infiltration into the contaminated site soil. This will be conducted through site surveying and possibly computer modeling. 3) Whether the cap provides an effective barrier to contact by biota with contaminants (determined primarily through site survey of the integrity of the cap), and 4) how long into the future will the current cap will remain as an effective appropriate barrier. Upon these determinations an array of innovative solutions will be presented for the long-term remedy at the site and the most feasible option proposed.

The goal of the project will be to reduce (or eliminate) arsenic discharge from the site to the Kewaunee River and to assure that direct contact with arsenic is not occurring and will not occur in the future so as to not impact any biota that rely upon the Kewaunee River and Lake Michigan. Specifically, compliance with the site specific discharge standards and/or critical levels regarding the aquatic ecosystem will be used as a benchmark for alternatives evaluated as part of the project. The alternatives considered will be evaluated through computer modeling to predict their performance.

Project Milestones:	Dates:
Project Start	12/2000
Winter Field Sampling	03/2001
Spring/Summer Field Sampling	06/2001
Biological Study Results	10/2001
Data Analysis/Groundwater Model Creation	02/2002
Remedial Alternative Evaluation	05/2002
Draft Report	07/2002
Final Report	12/2002

Project Addresses Environmental Justice

If So, Description of How:

Arsenic uptake could be detrimental to the fish population utilizing waters effected by the site. Low income people living in the area of the Kewaunee River may be living on a sustenance diet made up primarily of fish caught locally. If this situation exists any action to reduce arsenic concentrations in surface water would provide benefit to those populations.

Project Addresses Education/Outreach

If So, Description of How:

All documents created previously related to this site, and as part of this project, are public record. Routinely WDNR gets inquiries from landowners, potential landowners, and general interested parties regarding clean-up projects conducted. Interested parties may review the case and discuss issues related to the site with staff familiar with the case.

In addition, a public information and participation process is integral to all clean-up actions conducted by WDNR. Public notice of the action is completed and in many cases public meetings are conducted to involve the public in the process.

Project Budget:

	Federal Share Requested (\$)	Applicant's Share (\$)
Personnel:	0	0
Fringe:	0	0
Travel:	0	0
Equipment:	0	0
Supplies:	0	0
Contracts:	150,000	0
Construction:	0	0
Other:	0	0
Total Direct Costs:	150,000	0
Indirect Costs:	0	0
Total:	150,000	0
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

Funding identified above would be used to hire a consultant to conduct the study described, thus all requested funds are identified under the contracts category.

WDNR will provide staff time as needed and other non-cash support.

State funding for the project is a possibility.

Description of Collaboration/Community Based Support:

WDNR initially worked with the Fox Valley and Western Railroad to coordinate investigating, fencing and interim capping of a portion of the site. There are complicated legal issues relating to past involvement with the railroad at this site, regardless, funding for continued investigation and remediation will likely be pursued from the railroad. Railroads have come under increasing scrutiny by area communities for a myriad of reasons including noise, speed, and crossing safety. Thus a collaborative cleanup effort would certainly help their image in the Kewaunee area.

The spill location is in an area with human access primarily limited to hunting and fishing enthusiasts. The site is located in an environmentally sensitive glacial outwash plain where the Kewaunee river enters into Lake Michigan. Several hundred acres surrounding the site are within a large public land area which includes prime aquatic and terrestrial habitats. In fact, the area was renamed for the late Buzz Besadny, a long time WDNR Secretary and native son of Kewaunee. In time, the abandoned railroad bed may be purchased by WDNR and added the already extensive "rails to trails" network. We would expect interest from local groups representing hunting and fishing enthusiasts.

In recent years, WDNR has formed Geographic Management Units (GMUs) encompassing major watersheds to allow for a more systematic ecological management approach. The involvement of citizens, nature, and sporting groups has become a priority in helping WDNR manage these GMUs. Smart land use and habitat protection have reached a much higher level of community interest and involvement over the last couple of years. The average citizen is much more aware of critical environmental issues and this is evidenced by increasing turnout at hearings, round tables, and other meetings concerning the environment and recreation areas. It is thought that community support for a final cleanup would be appreciated and welcomed.