



## United States Department of the Interior

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Water Resources Division  
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IN REPLY REFER TO:

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EFMO/General

### Memorandum

To: Superintendent, Effigy Mounds National Monument (EFMO)

Through: Chief, Water Resources Division

From: Joel Wagner, Wetland Scientist, Water Resources Division  
Michael Martin, Hydrologist, Water Resources Division

Subject: Evaluation of streamflow and sediment discharge into Founders Pond

### Problem Statement

Founders Pond is a 40-acre wetland complex located on a low terrace or floodplain of the Yellow River within Effigy Mounds National Monument (Figure 1). The pond is predominantly submerged and floating-leaved aquatic wetland habitat, bordered by emergent, scrub-shrub, and floodplain forest wetlands. This site's exceptional fish and wildlife habitat and other ecological values, coupled with the tremendous loss of comparable wetland habitat in the state (over 90% of Iowa's wetlands have been destroyed), make it an important resource for EFMO and the region as a whole.

Founders Pond has been experiencing a dramatic increase in sedimentation over the last hundred and fifty years, and it is extremely likely that it will ultimately be compromised as a viable aquatic environment. Changes in land use, specifically agricultural activities in the upper watershed, are the probable cause of the increased sedimentation. Considering the widespread distribution of this type of activity, substantially reducing or eliminating sediment input is probably not a possibility. Park staff also believe that the channel delivering sediment from this watershed may have been manipulated by past farming activities and routed directly toward Founders Pond. Consequently, park staff would like to evaluate management options that could extend the life of this rare habitat type.



**Figure 1** – Panoramic view of Founders Pond looking east (NPS, 2007). The sediment encroachment is on the right side of the photo and is expressed as a series of progressively taller vegetation stands.

One possible solution that would be fairly simple and probably very effective would be to divert the intermittent drainage that delivers sediment to Founders Pond to a different location on the floodplain. A diversion berm made of local alluvium could easily be constructed at the head of the alluvial fan formed by the drainage. Such a structure would redirect flow and sediment towards a relatively low portion of the floodplain to the east, well removed from Founders Pond.

## **Site Description**

### Founders Pond

A natural levee formed by overbank flows of the Yellow River helps to impound water within Founders Pond. The open water and saturated conditions are maintained primarily by a sub-aqueous spring, evidence of which is obvious during winter months when up-welling is visible in an otherwise frozen pond. Additionally, periodic over-bank flows from the Yellow River, toe slope drainage out of the adjacent limestone highlands, and seepage from the alluvial fan all supplement Founders Pond.

According to Sanchini (1999), dominant submerged aquatic vegetation species in Founders Pond include pondweed (*Potamogeton spp.*) and coontail (*Ceratophyllum demersum*). Water lily (*Nuphar luteum*) was reported in that study as the most common floating-leaved aquatic plant, but from a distance, it appeared that American lotus (*Nelumbo lutea*) is also well-represented. Emergent wetland species include arrowhead (*Sagittaria spp.*), cattail (*Typha spp.*), and rice cutgrass (*Leersia spp.*). The scrub - shrub wetland on the eastern border of Founders Pond is predominantly willows (*Salix nigra*), and forested wetlands in that area include swamp white oak (*Quercus bicolor*) and silver maple (*Acer saccharinum*) (Figure 1).

This wetland complex provides exceptionally high value habitat for fish and wildlife, including migratory and resident waterfowl, wading birds, songbirds, raptors, fish, mammals, and

amphibians. Sanchini (1999) reported that Founders Pond has the highest invertebrate densities and species richness of the park's pond habitats. These wetlands also have a great capacity to improve water quality (sediment retention and nutrient filtration), store floodwaters, and regulate base flows on the lower Yellow River.

The value of this protected wetland complex is magnified because of the tremendous loss of wetlands in Iowa since the mid-1800s. Various studies estimate that the state has lost over 90% of the 4 million+ acres of wetlands that existed in the early 1800s, mainly due to drainage and conversion to farmland. Therefore, this 40-acre wetland complex at Founders Pond contributes significantly to the state's remaining wetland habitat, estimated by various authors at only about 100,000 – 400,000 acres (Bishop and van der Valk, 1982; Dahl, 1990).

Given the pond's location on a low terrace that periodically floods, both from the mainstem river and a tributary drainage, some sedimentation is inevitable. However, a recent pollen study, which analyzed sediment cores from Founders Pond, indicates a marked increase in sedimentation over the last 150 years. More specifically, sedimentation rates between about 9000 and 150 years ago ranged from about 0.05 to 0.1 cm/year. However, within the last 150 years the estimated rate is 1.045 cm/year, an increase of greater than an order of magnitude (Bogen and Hotchkiss, 2007). This apparent increase in sedimentation rate is likely the result of widespread agriculture that came with European settlement.

### Unnamed drainage

The terrace that supports Founders Pond periodically receives both water and sediment from a steep, intermittent watercourse that drains a catchment with an area of about 1 square mile. The channel experiences a dramatic break in gradient at the highlands/terrace boundary, and a broad, low-relief alluvial fan has formed at this location. Although the stream does not support perennial flow, it appears to be capable of transporting large amounts of both fine and coarse grained sediment during periodic runoff events.

Interestingly, on July 17, 2007, two days before our site visit, the area around EFMO experienced a series of intense and prolonged thunderstorms that led to several instances of local flooding. Although no measurements of precipitation were made at EFMO, the nearby municipality of Prairie Du Chien received from about five to seven inches over a 24-hour period. As a result of the storm, the unnamed drainage that feeds Founders Pond experienced a substantial flow event that caused a temporary flow redirection away from the pond when the primary channel changed course on its fan. During this flood event, a substantial amount of large cobble and small boulder sediment was deposited in the channel at the upper end of the alluvial fan (Figure 2). For at least a time, a great deal of the flow was directed to the east towards the relatively low area on the floodplain. Before the channel could completely avulse and form a new channel in a new alignment, enough woody debris collected in the standing timber to re-direct flow back to the original channel. The timing of our site visit also indicated how short-lived flows are in this channel, even after large rain events. Two days after a substantial rain event that produced local

flooding in the area, there was no channel flow at the proposed diversion area. Therefore, the biological values of this intermittent, high sediment load channel are expected to be relatively low.



**Figure 2** – View of boulder/cobble bar deposited in main channel on alluvial fan (NPS, 2007). Unobstructed flow direction was from bottom right of picture towards top left. After the deposition and diversion, the flow direction shifted towards the top right of the photo. Note the position of the herbaceous vegetation on the right bank of the creek as a proxy indicator of flow direction.

## **Discussion**

It appears from the general topography of the area that diverting the unnamed drainage away from Founders Pond would pose a viable solution to the sedimentation issue. As mentioned, the drainage has formed a sizable alluvial fan on the low terrace that supports Founders Pond. This fan is located to the east of the pond, and is encroaching on the east portion of the pond (Figure 3). A reconnaissance of the upper fan and the surrounding area indicated that a favorable gradient exists to divert the channel towards the east, and away from the pond. Alluvial fans are formed

by a combination of sediment deposition and shifting channels, so a man-made shift in flow is not outside the natural geomorphic regime. This is well evidenced by the near avulsion (change in channel course) that took place just prior to our visit.



**Figure 3**– Photo of distal end of alluvial fan where it enters Founders Pond (NPS, 2007). Note the sequence of varying heights of the vegetation cover indicative of encroaching sediment in an aquatic environment.

Manipulation of flow on all sizes of alluvial fans for the purposes of agriculture and occupation has been undertaken for centuries. Due to the aggradational nature of fans, these diversions are often temporary but may persist for many years or decades, possibly much longer, depending on conditions. However, continual monitoring and periodic maintenance (especially after large flow events) is usually required. In this particular case, the required manipulation would be fairly small, probably on the order of 30-50 cubic yards of local material, and due to the intermittent flow, may require little maintenance.

One substantial concern, however, is the receiving area of the redirected sediment discharge. We were not able to directly assess this area, but portions of the floodplain east of the fan appeared to be forested wetland. In the long term, periodic sediment influx could extend the toe of the fan into portions of this wetland area, causing some conversion to upland forest. However, we must keep in mind that alluvial fans are inherently very dynamic systems, and, regardless of which way the intermittent drainage is directed, there will be sediment deposition and potential change/conversion of wetland characteristics somewhere along the toe of the fan. In this case, by routing the channel to the east, the park would be making a decision that the benefits of protecting the functions and values of Founders Pond from anthropogenic sedimentation are greater than any potential conversion of forested wetland further to the east, over the long term.

A final issue is wetland compliance. Any proposed action of this type must meet the requirements of NPS Director's Order #77-1: Wetland Protection and Section 404 of the Clean Water Act. Regarding NPS wetland compliance, D.O. #77-1 only comes into play when a proposed action would have *adverse* impacts on wetlands. Since redirecting the intermittent channel would mitigate the harmful effects of excess sediment deposition in Founders Pond, the proposed action would produce *beneficial* effects on that resource. Redirection of discharge near the apex of the fan would eventually move sediment toward wetlands at the eastern edge of the fan. However, since this is a naturally dynamic environment that would definitely move sediment in that direction at some time in the future even if we took no action, we don't consider this redirection an adverse impact on wetlands.

Compliance with Section 404 of the Clean Water Act involves several steps. First, we need to determine if the U.S. Army Corps of Engineers claims regulatory jurisdiction over the channel. If they do claim jurisdiction, then the Corps must determine the type of 404 permit required (nationwide or individual). The NPS must then submit the appropriate application and supporting documentation, and the Corps would make a decision on the permit. If the Corps does not claim jurisdiction, then no further action is needed under Section 404.

On September 28, 2007 we contacted Ms. Donna Jones of the Corps of Engineers, Rock Island District, Regulatory Branch to describe the resource and issue, explain the proposed management activity, and determine a course of action for compliance with Section 404 of the Clean Water Act. Following is a summary of that conversation:

- Whether or not the Corps claims regulatory jurisdiction depends on the type of hydrologic connection that the channel at the diversion point has to Founders Pond and associated wetlands. If there is a *continuous channel with a defined bed and bank* connecting the diversion point to the wetland system, then the Corps will claim jurisdiction and a permit will be required. If instead, the channel dissipates near the wetland area and water and sediment is distributed more as diffuse overland flow or sheetflow, then the Corps may not claim jurisdiction. So, the first step is to make this determination in the field and prepare photo documentation.

- Ms. Jones recommended that the NPS should prepare a letter (or application form) and submit it to her to document the situation and request a determination. The letter/form would need to include a map or air photo indicating the location of the proposed action in relation to waters of the U.S. (the channel on the fan and Founders Pond), specific geographic location information such as Section, Township, and Range, and a summary of the proposed action and reasons for doing it. This would include photos of the proposed diversion point, but also should include photos of the connection to the Founders Pond wetland area, especially if we want to make the case that there is not a defined bed and channel connection.
- The letter/form would need to make the case that the proposed action would not adversely affect the hydrology of Founders Pond, its associated wetlands, or other water resources in the vicinity. A key topic to also address is any effect on archeological or cultural resources. She was particularly concerned about effects on such resources that the park was created to protect (e.g., mounds or related features), but also wants to know about effects on any other cultural/archeological resources.
- Ms. Jones will respond regarding whether or not a permit is needed, what type of permit would be required if the Corps claims jurisdiction, and what additional supporting documentation would be necessary to process a permit (e.g., formal wetland delineation, wetland functional assessments, etc.).

## Summary

Based on recent sediment cores taken from Founders Pond, it appears that the sedimentation rate has increased as much as an order of magnitude (from about 0.1 cm/year to over 1.0 cm/year) over the last hundred and fifty years. This is of great concern to the health and existence of Founders Pond, since even a few inches of elevation change due to sediment accumulation could cause the conversion or loss of these valuable wetlands. At the present estimated sedimentation rate of about 1.045 cm/year, the existing habitat could be severely compromised within a few decades. Reducing the amount of sediment delivered from the source is not a viable treatment, as most of the watershed is outside of the park.

Diversion of the intermittent stream that periodically delivers water and sediment to Founders Pond appears to be a treatment that would be both effective and fairly easily accomplished. The point of diversion would be near the apex of an alluvial fan formed by the creek and, therefore, would fit well within the natural geomorphic processes of this area. Although the new receiving area for runoff and sediment would be the eastern flank of the fan, and potentially the forested wetlands further east on the floodplain, the park could make a reasonable determination that the channel would have eventually migrated in that direction naturally, and that the benefits to Founders Pond outweigh any such concerns. Consultation with the Corps of Engineers is necessary to assure that the proposed action would be performed in compliance with Section 404 of the Clean Water Act.

## References Cited

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