

Aitkin County Board of Commissioners
Request for County Board Action/Agenda Item Cover Sheet



To: Chairperson, Aitkin County Board of Commissioners Date: 1-31-12

Via: Patrick Wussow, County Administrator

From: John Welle

Title of Item:
Partial Abandonment Request for Portions of County Ditch 4 and 38

Requested Meeting Date: 2-7-12 Estimated Presentation Time: 10 minutes

Presenter: John Welle

Type of Action Requested (check all that apply)

- For info only, no action requested Approve under Routine Business
- For discussion only with possible future action Adopt Ordinance Revision
- Let/Award Bid or Quote (attach copy of basic bid/quote specs or summary of complex specs, each bid/quote received & bid/quote comparison)
- Approve/adopt proposal by motion Approve/adopt proposal by resolution (attach draft resolution)
- Authorize filling vacant staff position
- Request to schedule public hearing or sale Other (please list) _____
- Request by member of the public to be heard
- Item should be addressed in closed session under MN Statute _____

Fiscal Impact (check all that apply)

- Is this item in the current approved budget? Yes No (attach explanation)
- What type of expenditure is this? Operating Capital Other (attach explanation)
- Revenue line account # that funds this item is: _____
- Expenditure line account # for this item is: _____

Staffing Impact (Any yes answer requires a review by Human Resources Manager before going to the board)

- Duties of a department employee(s) may be materially affected. Yes No
- Applicable job description(s) may require revision. Yes No
- Item may impact a bargaining unit agreement or county work policy. Yes No
- Item may change the department's authorized staffing level. Yes No



Supporting Attachment(s)

- Memorandum Summary of Item
- Copy of applicable county policy and/or ordinance (excerpts acceptable)
- Copy of applicable state/federal statute/regulation (excerpts acceptable)
- Copy of applicable contract and/or agreement
- Original bid spec or quote request (excluding complex construction projects)
- Bids/quotes received (excluding complex construction projects, provide comparison worksheet)
- Bid/quote comparison worksheet
- Draft County Board resolution
- Plat approval check-list and supporting documents
- Copy of previous minutes related to this issue
- Other supporting document(s) (please list) Petition

Provide eleven (11) copies of supporting documentation **NO LATER THAN Wednesday at 8:00am** to make the Board's agenda for the following Tuesday. Items **WILL NOT** be placed on the Board agenda unless complete documentation is provided for mailing in the Board packets. (see reverse side for details)

AITKIN COUNTY COMMISSIONER'S MEMO

TO: Aitkin County Commissioners
Patrick Wussow, County Administrator

FROM: John Welle

DATE: February 1, 2012

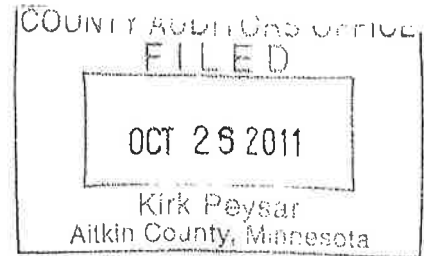
REGULAR AGENDA ITEM: Partial Abandonment Request for portions of County Ditch 4 and 38

Late last October, we received the attached petition for partial abandonment of portions of County Ditch 4 and 38 located in Section 27, 28, 32, 33, and 34 of Workman Township on PMT Montana LLC property. The reason for the requested abandonment is to restore hydrology to the existing small grain fields as part of a wetland replacement site that is currently being proposed by U.S. Steel.

The field review and engineers report of this partial abandonment cannot take place until the spring, but I wanted to present this petition to the Board and acknowledge it's receipt for future action.



U. S. Steel Corporation
Minnesota Ore Operations
P.O. Box 217
Keewatin, MN 55753



October 24, 2011

Mr. Kirk Peysar
Aitkin County Auditor
209 2nd Street NW
Room 202
Aitkin, MN 5643-1292

**RE: Petition for Partial Ditch Abandonment of a Drainage System
within Sections 27, 28, 32, 33 and 34 of Workman Township (T.49N.-R.24W.)
Aitkin County, Minnesota
HMM Project #293818AA01**

Dear Mr. Peysar:

United States Steel Corporation (U. S. Steel) is submitting this petition for ditch abandonment at the locations referenced above pursuant to Minnesota Statute 103E.806, "*Partial Abandonment of a Drainage System.*" Under Minnesota Statutes 2010 103E.806, this petition is filed with the Aitkin County Auditor.

This ditch abandonment request is a part of a wetland mitigation project with miles of ditches flowing through the U. S. Steel wetland mitigation site. The project site is approximately 1,416 acres within U. S. Steel's approximate 4,434-acre property. The attached hydrologic report summary shows that these headwater ditches no longer serve a substantial useful purpose as part of the drainage system to any property remaining in the system and are not of a substantial public benefit and utility. Also, note that all ditch assessments and historical ditch liens have been recently removed and recorded for the entire 4,400-acre agricultural property.

Please review the attached summary report and figures. Note that based on the available public County ditch data and mapping, it is not entirely clear in some areas which ditch sections the County would claim jurisdiction, as the ditches flow on both sides of the four principal farm roads and several ditches appear to be private ditches based on their design and connections on and adjacent to the mitigation site. The County ditch maps also appear to show only a network of single channels and fewer farm roads, which when reviewing historical aerials appears to have been the original condition.

It appears that some of the County ditches have been replaced over the years by newer ditches and with different outfalls and sometimes even with reversed flow directions as a result of re-routing. Consequently, there is some uncertainty regarding whether the County would claim jurisdiction over what may have been historical private ditches that connected County labeled ditches or between offsite properties that drain through the wetland mitigation site. We request that the County please clarify these uncertainties and correct our ditch mapping as necessary.

U. S. Steel is requesting permission to abandon the following ditch segments that we believe are under the County jurisdiction in Workman Township. These segments are further described in the attached supporting documents:

- Section 27: The segment of CD-4 bounding the west side of the SW quadrant.
- Section 28: The segment of CD-4 bounding the east side of the SE quadrant of the SE quadrant.
The segment of CD-4 & FRC-B bounding the entire south side of the Section.
The segment of CD-4 bounding the west side of the SW quadrant of the SW quadrant.
- Section 32: The segment of FRC-A bounding the north side of the Section, except the NW quadrant of the NW quadrant. Note that this description includes the ditch segment along the north side of the NE quadrant of the NE quadrant of Section 32, which appears to be a private ditch, as it is excluded from the County system in available County mapping. The local segment of FRC-A that drains through into CD-38.
The segment of CD-38 along the south side of the north half of the Section, except the SW quadrant of the NW quadrant.
The segment of CD-38 along the east side of the north half of the Section.
- Section 33: The segment of CD-38 along the west side of the north half of the Section.
The segment of CD-4 & FRC-B bounding the entire north side of the section.
The segment of CD-4 & FRC-B bounding the east side of the north half of the section.
- Section 34: The segment of CD-4 & FRC-B bounding the entire west side of the S
The segment of CD-4 along the south side of the NE quadrant. ←
The segment of CD-4 along the entire north side of the south half of the ↗

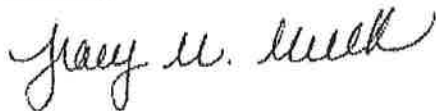
U. S. Steel is also considering abandonment of the following private ditches, which are under the jurisdiction of the County ditch authority, based upon available County mapping. If the County ditch authority considers any of the following ditches to be regulated, please add them to the list above for which permission to abandon is sought:

- Section 27: The ditch segment bounding the south side of the SW quadrant.
The N/S-oriented ditch segment dividing the SW and SE quadrants of the SW quadrant.
- Section 28: The N/S-oriented ditch segment dividing the SW and SE quadrants of the SE quadrant.
- Section 32: The N/S-oriented ditch segment dividing the east and west halves of the NW quadrant.
The ditch segment bounding the north side of the NE quadrant of the NE quadrant. (This is the segment through which the local segment of FRC-A drains into CD-38, as mentioned above).

Section 34: The ditch segment bounding the north side of the NW quadrant.
 The E/W-oriented ditch segment dividing the NW and SW quadrants of the NE
 quadrant.
 The ditch segments bounding the east and south sides of the south half of the
 Section.

Should there be any questions about this submittal or if you require additional information,
please contact our consultant, Robert Lin at (973) 912-2581 or at robert.lin@hatchmott.com.

Sincerely,



Tracy M. Muck
United States Steel Corporation
Minnesota Ore Operations – Keetac
Environmental Control

cc: Daryl Wierzbinski (USACE)
 Jill Clancy (USACE)
 Kate Paul (MNDNR)
 Chrissy Bartovich (USS)
 Dennis Hendricks (USS)
 Joshua Zika (USS)
 Julie Smock (USS)
 Robert Lin (HMM)

Supporting Documentation for Proposed Partial Abandonment of a Drainage System

Project Description

The 1,416-acre wetland mitigation project site is located approximately 2 to 3 miles southeast of the City of Palisade, Aitkin County, Minnesota. The wetland mitigation area consists of portions of Sections 27, 28, 32, 33, and 34 in Workman Township (T.49N-R.24W). The mitigation project site is a northern portion of a larger U.S. Steel-owned tract of land that also includes portions of Section 29 of Workman Township, Section 36 of Logan Township (T.49N-R.25W) and Sections 3, 4, 5, and 6 of Jevne Township (T.48N-R.24W). A 1973 U.S.G.S. Site Location Map and 2009 Aerial Map, with the limits of the proposed mitigation site, are presented below in Figure 1 and Figure 2, respectively.

Based on a hydrologic investigation of the U. S. Steel property, surrounding areas and subsequent ditch flow study to include upstream properties adjoining the 1,416-acre project area, U. S. Steel is petitioning for a partial abandonment of a drainage system for specified ditch segments located on the U. S. Steel property. Please note that all of these ditch segments under this petition would not necessarily be abandoned immediately, but would occur in phases over the next several years as the wetland mitigation project progresses.

The following summary report is submitted in support of this petition for partial abandonment of the drainage system. This summary is based upon a more comprehensive wetland mitigation report submitted to the Army Corps of Engineers and Minnesota Department of Natural Resources. If the Aitkin County ditch authority requests to review the entire wetland mitigation report, including a more detailed hydrology/hydraulic study for the entire local region, a copy would be made available upon request.

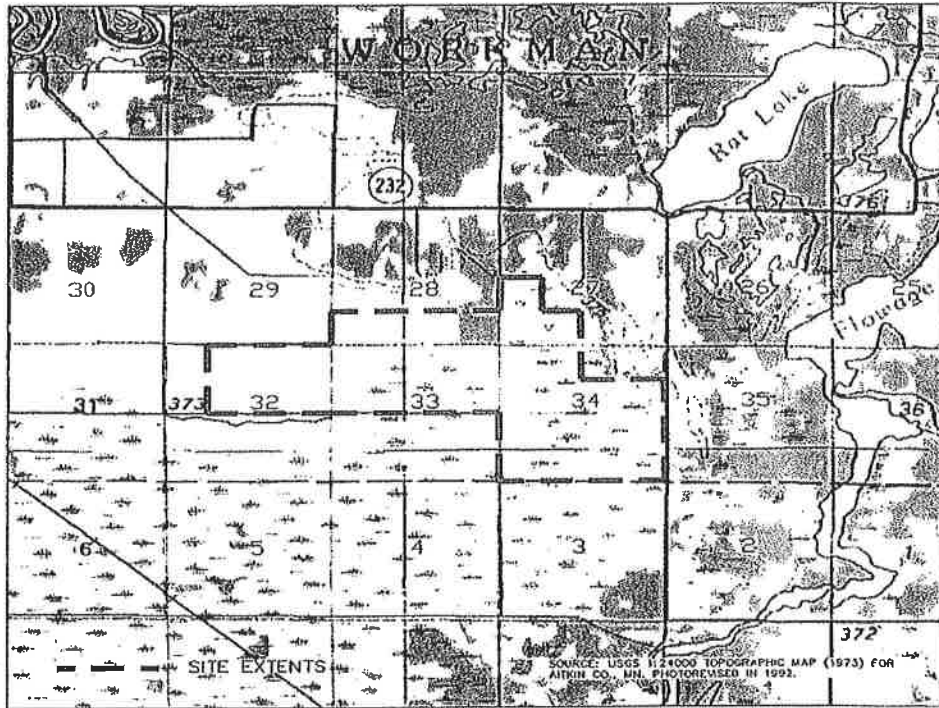


Figure 1 - USGS Site Location Map



Figure 2 - Aerial Map (2009)

Summary Report

Aitkin County drainage ditches were established under several different Minnesota statutes and methods, creating four different types of regulated ditches:

1. Fire Relief Commission Ditches
2. State Drainage Ditches
3. County Drainage Ditches
4. Judicial Drainage Ditches established by District Court action and usually located in two or more counties.

All four ditch types are the responsibility of the courts and under the jurisdiction of the County ditch authority. Representatives of all ditch types are found on the U. S. Steel property except for number 4, judicial drainage ditches.

Of the four types of regulated ditches noted above, only two, County Ditches (CD-) and Fire Relief Commission (FRC-) ditches, pertain to this petition. The locations of these regulated ditches are indicated on the ditch map (dated May 11, 2011) obtained from Aitkin County (Figure 3). There are also approximately 4.5 miles of private ditches within the 1,416-acre wetland mitigation site shown on Figure 4. These private ditches were investigated and mapped because they discharge into the County ditches and are therefore, dependent upon the latter in order to continue draining. The ditch map from Aitkin County (Figure 3) was modified with reference labels and U. S. Steel request confirmation that all of the mapped private ditches are unregulated by the County ditch authority and that they could be abandoned without petition.

County Ditch Summary

There are four county ditch designations on the 1,416-acre U. S. Steel property. These are CD-4, CD-38, FRC-A, and FRC-B. In three locations, there are overlaps between CD-4 and FRC-B. Following the convention employed on maps available on-line from Aitkin County, these areas of overlap have been designated "CD-4 & FRC-B". There is no location on the site where FRC-B exists independently of CD-4.

The county ditch system is intended to drain the properties of individuals that may benefit from the drainage. Ditches that are not designated either CD-4, CD-38, FRC-A, or CD-4 &

FRC-B are considered private ditches. All ditches on the designated wetlands mitigation site, whether county ditches or private, ultimately drain through CD-38, either by discharging directly to one of its branches or indirectly through sections of FRC-A, CD-4, or “CD-4 & FRC-B”. With the exception of CD-38, which throughout the U. S. Steel property, seems to be a simply-branched system of Strahler (1952) first- and second-order tributaries and a single third-order stem, the local county ditch designations do not appear to reflect any common discharge point. For example, in contrast to the county maps, portions of CD-4 ultimately drain out through FRC-A or CD-38. County mapping indicates that the diagonal ditch in the northwest quadrant of Section 29 is part of CD-4. The northwest half of the diagonal ditch appears to drain to the ditches along Route 232. The southeast half of the diagonal ditch drains, via a circuitous route (which involves flow through two private reaches), to FRC-A, which eventually joins the most downstream portion of CD-38 before flow in CD-38 reaches the large culvert that passes under Route 232.

The entire ditch system was analyzed to determine which ditch segments are *“not of public benefit and utility and does not serve a substantial useful purpose to property remaining in the system”* (2010 Minnesota Statute 103E.806 Subdivision 1).

The potential impacts to adjacent properties from any ditch abandonment were reviewed as to whether the ditches in question could be abandoned under Minnesota law. That is, to determine at a hearing whether *“that part of the drainage system does not serve a substantial useful purpose as part of the drainage system to any property remaining in the system and is not a substantial public benefit and utility”* (2010 Minnesota Statute 103E.806 Subdivision 3(a)).

All drainage ditches (regulated and private) on and adjacent to the mitigation site were reviewed. Each regulated ditch on the site has been assigned into one of four groups, according to the type and level of potential impacts that may result from abandonment. Private ditches were similarly assessed depending upon whether abandoning them could adversely affect adjacent properties.

Group 1 Ditches

Group 1 ditches are Aitkin County regulated ditches and private ditches that do not convey any drainage originating from properties other than the mitigation site.

Abandoning these ditches would have negligible if any impacts to offsite properties.

The locations of these ditches are highlighted in solid and dashed green lines on Figure

4. U. S. Steel is requesting that these County regulated ditch sections be approved for partial drainage system abandonment. The pertinent ditch segments include: a short part of CD-4 that bounds the east side of the SE quadrant of Section 28, a portion of FRC-A on the north side of Section 32, the portion of CD-38 that bounds the south side of the north half of Section 32, the portion of CD-4 & FRC-B that bounds the entire north side of Section 33 and the entire west side of Section 34, and the portions of CD-4 that bound the north side of the south half of Section 34 and the south side of the NE quadrant of Section 34.

The current plan calls for abandoning the ditch sections in phases to increase the amount of water to sustain wetlands hydrology on the mitigation site. The abandonment of ditches in some areas are also contingent upon the availability of fill material, either to be acquired from removing adjacent private farm roads or by bringing in suitable clean fill. In some cases, the partial fill material can be provided by moving berms that are currently planned around the perimeter in-lieu of ditch abandonment around the parcels.

Group 2 Ditch

Group 2 ditch is comprised of only one Aitkin County regulated ditch segment (part of "CD-4 & FRC-B") associated with the Great River Energy easement. This Group 2 ditch segment is highlighted by a solid blue line in Figure 4, located along the southern border of Section 28.

Abandoning this ditch section would not impact any off-site properties under normal precipitation years. However, abandoning any portion of the western three quarters of this ditch (i.e., downstream and west of the confluence with the north/south-oriented private ditch that introduces flow from the off-site eastern half of Section 28) could cause an increase in the frequency of inundation on a small portions of the unimproved southern end of the McClelland property and adjacent woodland during severe precipitation or snow-melt events and especially during wet years. Please refer to the Adjacent Property Owner's Map in Figure 5. The portions of the upstream properties that may be impacted are predominantly vegetated wetlands. U. S. Steel requests that this portion of the CD-4 & FRC-B (shown in blue) drainage system be abandoned since they do not serve a substantial useful purpose or serve a public benefit and utility as the potential of any impact would be considered minimal.

The current plan is to leave this ditch section open due to the lack of fill material and instead, plug up one or more culverts to increase surface water inflow onto the adjacent mitigation parcels.

Group 3 Ditches

Group 3 ditches are ditches that convey drainage from off-site wooded, shrub, and/or wetland areas. The locations of these ditches are highlighted in solid and dashed brown lines on Figure 4. The pertinent locations of these ditch segments include: the portion of CD-4 that bounds the west side of the SW quadrant of Section 28 and two segments of CD-38 that bound the east side of the north half of Section 32 and the west side of the north half of Section 33.

If these ditches were to be abandoned, increases of inundation frequency and minor increases of saturation on adjacent parcels could occur from severe precipitation or snow-melt event and especially during a wet year. In general, abandonment of these ditch sections would have negligible to minor impacts and only upon existing woodlots. As noted, an extreme wet event could impact the most southern section of the McClelland farm the adjacent woody areas from these Group 3 Ditches. Please refer to the Adjacent Property Owner's Map in Figure 5. U. S. Steel is requesting that these ditch sections also be approved for partial drainage system abandonment as impacts would not be substantial unless extreme weather conditions occur and would only then impact lower portions of the McClelland farm and adjacent wetland woodlots.

Group 4 Ditches

Group 4 ditch sections are all Aitkin County regulated ditches that convey drainage from an off-site property where an increase in the frequency of inundation could affect the arability of the land, if these ditch sections were abandoned. The expected frequency of inundation would increase under normal circumstances, and the amount of inundation could be minor to moderate after heavy precipitation, especially during a wet year. The locations of these ditches are highlighted in solid and dashed magenta lines on Figure 4. The pertinent locations on the mitigation site include: the portion of CD-38 bounding the south side of the north half of Section 33, the portion of CD-4 & FRC-B bounding the east side of the north half of Section 33, and the portions of CD-4 bounding the west side of the SW quadrant of Section 27 and the south side of the NW quadrant of Section 34.

U. S. Steel is not requesting partial drainage system abandonment for these County regulated ditch segment due to potential impacts to adjacent properties. Should property ownerships change or potential inundation impacts are altered by the storage capacity of the design wetlands, then U. S. Steel reserves the right to petition these segments at a later date if circumstance change from the current inundation status.

Private Ditches (shown as dashed lines on Figure 4)

Private ditches on the 1,416- acre mitigation site are not shown on the County Ditch Map (Figure 3) but have been indicated on Figure 4. Most of these private ditches will remain unaltered during this initial phase of work, but U. S. Steel may abandon them if necessary without further notice to the County ditch authority.

There are on-site private ditches that do not convey any off-site drainage. These are on Figure 4 highlighted by green dashed lines and are analogous to regulated ditches in Group 1. Similarly, filling them would have negligible impact on off-site properties. These ditches may be filled as needed to help maintain wetlands hydrology on the adjacent mitigation site parcels. The pertinent locations on the mitigation site include: the ditch bounding the south side of the SW quadrant of Section 27, the N/S-oriented ditch dividing the SW and the SE quadrants of the SW quadrant of the Section 27, the ditch bounding the north side of the NW quadrant of Section 34, and the ditches bounding the east and south sides of the south half of Section 34.

Also shown on Figure 4 are on-site private ditches that convey off-site drainage flow described in Group 3 ditches. Filling these private ditches could increase the frequency of inundation in forested and/or wetlands and possibly the undeveloped southern portion of the McClelland farm. The locations of these ditches are highlighted in dashed brown. The pertinent locations on the mitigation site include: the N/S-oriented ditch that separates the SE and SW quadrants of the SE quadrant of Section 28, the N/S-oriented ditch that divides the east and west halves of the NW quadrant of Section 32 (furthest west segment), and a short E/W-oriented ditch segment that separates the NW and SW quadrants of the NE quadrant of Section 34. These private ditches may be filled as needed to help maintain wetlands hydrology on the adjacent mitigation site parcels but would likely remain open during this phase of work. Also, as the mitigation project progresses, full functioning mitigated wetlands of such size may alter future hydrology

significantly to allow abandonment of these private ditches without impacts to upstream properties.

Finally, there are private ditches that convey drainage from off-site properties and the arability of some properties could be impacted due to a potential increase (frequency/intensity) of inundation if these private ditches were to be abandoned. These private ditches are highlighted in Figure 4 by dashed magenta lines. These ditches include: the ditch segments that bound the north and east sides of the NW and SE quadrants of the SW quadrant of Section 27 and the east side of the NW quadrant of Section 34. Again, these private ditch segments would remain open during this phase of work and as full functioning mitigated wetlands may alter future hydrology significantly to allow abandonment of these private ditches with minor or no impacts to these upstream properties. The plan calls for these ditches to remain unaltered.

In the following section, an impact study is presented to the County ditch authority in support of this petition. The study includes an assessment of the upstream impacts expected due to the proposed abandonment of these County and private ditches. Of the four groups of regulated ditches, U. S. Steel is requesting permission to abandon all but the ditches assigned to the highest-impact group (*i.e.*, Group 4). It is believed that ditches in this last group currently provide a substantial useful purpose and a substantial benefit and utility (*i.e.*, drainage for farmland and or dwellings) to adjacent property owners. U. S. Steel may not ultimately abandon all of the approved County ditch segments, especially if the water that would otherwise be retained is greater than needed for wetland mitigation. During the critical first years of the project, while the wetlands are being established, the water levels on the mitigation site parcels would be monitored and adjustments made to inflows. The intention will be to establish a balance where sufficient water will be retained to establish the wetlands communities on the site, while minimizing any excess storage that could cause an adverse impact to the present land use on neighboring properties.

The summary provides an analysis of partial ditch abandonment of public and private ditches and their potential to impact upstream properties.

I. Ditch Flow Assessment

The drainage system at the mitigation site was assessed in order to better determine the impact of partial abandonment and to provide recommendations for ditch closure and adaptive management. The hydrological ditch flow assessment involved four components: (1) the

establishment of a site-specific hydrological database, which includes meteorological data, water level data from ditch staff gauges and piezometers, and ditch flow measurements; (2) aquifer hydraulic testing; (3) a systematic analysis of the site's surface water drainage system; and (4) a numerical hydrogeologic model. The results of each are summarized below.

Wells and Piezometers Network

Monitoring wetland hydrology was necessary to establish baseline conditions and measure the response of a wetland to hydrologic alterations in the surrounding watershed. Piezometers were installed in order to monitor the water table fluctuations in response to precipitation events and seasonally. Piezometer water levels were measured on eleven occasions over the course of the 2011 growing season, between mid May and mid September. The measurements were used to interpolate the contours of the potentiometric surface at various stages of the growing season, compute the vertical and horizontal components of the hydraulic gradient, serve as observation points for aquifer pumping tests, and provide targets for the calibration of the numerical ground-water flow model.

In general, the water levels fall to the west. In individual parcels, the horizontal component of the hydraulic gradient is predominantly toward the ditches. However, in 2011, there were places where the ditches appeared to be losing water to the adjacent aquifer. Nevertheless, the water levels in the centers of every parcel were greater than in the ditches, indicating that the losing ditches are a transient condition, related to the relatively scant rainfall during 2011. This condition could only occur where there is normally a significant amount of seepage to deeper aquifers. The results of the numerical modeling strongly supports this conclusion, with the calibrated model indicating that approximately 5 percent of the annual recharge received on the mitigation site penetrates the confining unit between the shallow and deeper aquifers during a year of normal precipitation.

Dataloggers were installed in a well and three different ditch locations. The continuous water level record through the 2011 growing season indicates that there were three significant precipitation events that induced water-table and ditch-level rises in the range of 1.9 to 2.8 feet. In each case, there was a much slower return to the baseline trend, requiring approximately three weeks. However, this was not directly observed because the water level recession was interrupted in each case by subsequent smaller precipitation events. Throughout the season, the baseline water levels in both the aquifer and the drainage system also gradually fell, which is always expected, due to increased evapotranspiration during the warmer months.

The length of time required for water levels to return to the baseline is a clear indication that the mitigation site would be able to sustain wetlands hydrology, with the abandonment of selected ditch sections to raise the hydraulic baseline and the construction of berms to retain runoff on the parcels.

Aquifer Hydraulic Testing

The purpose of the pumping tests was to determine the hydraulic properties of the shallow aquifer that exists across the site, the degree of vertical heterogeneity and permeability within the substratum, and the extent of hydraulic connectivity of the aquifer with the ditch system. Eleven wells were subjected to constant rate pumping tests and the drawdown measured in the adjacent shallow/deep piezometer couplets.

The drawdown data were analyzed to calculate the transmissivity, hydraulic conductivity, storativity, and specific storage at each well location. For the hydrographs that were not affected by partial penetration, the image well and law of times method was used to calculate the radius to the image well. By comparing this calculated radius with the radius under ideal hydraulic connection with ditch, the amount of hydraulic resistance imposed by the bottom materials lining the ditches was estimated.

Ditch Flow Analysis

The Ditch Flow Diagrams, Figures 6 and 7, show the drainage pattern of the ditches for the proposed wetland mitigation project. Figure 6 is a flow diagram of the site drainage system superimposed upon a color infrared aerial photograph that can be used to identify the locations of the ditches with respect to other physical features of the site. Figure 7 shows the same diagram without the aerial image to facilitate the identification of critical channels and culverts that could be modified to increase the site water storage. For convenience, individual streamlines carried by the system are given a letter or number designation (A-Z, 1-9) and grouped (shown by color coding) according to the shared confluences. The official locations of county, state, and Fire Relief Commission (FRC) ditches are highlighted to facilitate comparison with existing ditches. It should be noted that the observed directions of flow and actual positions of ditches are not always as shown, based upon the official Aitkin County ditch mapping. In addition the locations of county ditches often fall along roads where there are two ditches on either side of the road, flowing in opposite directions. Where this occurs, both ditches are assumed to be included in the county ditch system.

For the most part, the flow in these ditches originates on the U. S. Steel property. Since the wetlands mitigation site includes some of the most up-stream portions of the property, most of the drainage originates on the mitigation site. This would be an important consideration in the determination of whether any partial abandonment can be approved in order to increase the amount of water available for wetlands restoration. However, a considerable portion of the drainage that flows through the mitigation site still originates directly off site. The effect of partial ditch abandonment that conveys this drainage has been carefully analyzed. This assessment should also note that most of the drainage that originates off site enters through private ditches that would not be reviewed by Aitkin County. Please refer to the Adjacent Property Owners Map in Figure 5.

Evaluation of Proposed Ditch Abandonment Effects

Ditch abandonment may be accomplished by either partly or completely abandoning a ditch by filling it with low-permeability material. Abandoning a ditch will have an effect on the surface-water outflow from adjacent and upstream sources, which may include any off-site drainage that makes use of the affected portions of the on-site ditch system. This will result in a greater frequency and depth of inundation, which is desirable for the restoration of wetlands on the site, but may not be suitable for adjacent areas.

If the effects of partial ditch abandonment and reduction of ground-water outflow result in sufficiently extensive water-table rise, off-site properties could be affected during times of high water, especially in extremely wet years.

In order to allow the drainage system to function and coexist with agricultural activities on adjacent properties, drainage needs to pass under roads and through corrugated steel culverts. The locations and orientations of these culverts are shown on Figures 6 and 7. For the purpose of testing or temporarily increasing storage, especially if dry years were to occur during the critical first years of restoration, the ditches may be temporarily blocked (and as necessary for adaptive management), by means of plugging on the upstream end. These plugs could then be removed when additional drain capacity is needed. Because it is known that the flow in some ditches near the mitigation site was able to circumvent clogged culverts, probably through piping of finer materials from the surrounding soil, the use of plugging as a permanent means of abandoning a ditch segment is not recommended.

Site surveys completed in October 2010 and May 2011 by E.G. Rud and Sons, Inc. confirmed the presence of several critical culverts that control the flow from large portions of the site.

These include:

- C1 Surface-water inflow from off-site portions of Section 29, draining through county ditch CD-4 and portions of Ditch M that are mapped as FRC-A, although it is completely separate from that ditch and flows in the opposite direction;
- C2 U. S. Steel parcel in Section 28 (except that which drains through Ditch J) and surface-water inflow from off-site portions of Section 28;
- C4 Portion of the U. S. Steel parcel in Section 28 that drains through Ditch J plus all flow from Section 27 that enters through culvert C10;
- C6 Northeastern portion of the U. S. Steel parcels in Sections 27, some surface-water inflow from adjacent off-site portions of Section 27, the U. S. Steel parcels in the north half of Section 34, and off-site surface-water inflow from the northern half of Section 34;
- C8 Controls flow for the entire southern half of Section 34;
- C10 Northwest, central, and southern portions of the U. S. Steel parcels in Section 27 and some surface-water inflow from off-site portions of Section 27;
- C16 Northern half of Section 32 (except the most western 80 acres) and surface-water inflow from off-site portions of Section 29 through county ditch CD-4 and Ditch M (which may be considered a part of FRC-A), via culvert C1;
- C18 Controls flow for the entire mitigation site (including all of the flow through culverts C8 and C19), associated surface water inflow from off site, and the southern half of Section 33 (which is owned by U. S. Steel, but is not in the presently designated mitigation site); and
- C19 All wetland mitigation site parcels in Sections 27, 28, 32, and 33 and the north half of Section 34 and all off-site surface-water inflow from Sections 27, 28, 29, and 34.

Each of these culverts could be used to restrict the flow in upstream ditches and cause water to flow from the ditches onto upstream parcels of land, which can be modified to direct flow to various parcels or design basins. This would also increase the average annual recharge, thus maintaining a higher water table. This could also be accomplished by abandoning the ditch

immediately upstream of the selected culvert, which would reduce the likelihood of piping around a culvert and the resultant development of subsurface outflows or losses.

When modifying ditches for the purpose of creating impoundments for retaining water, it is important to select spillway elevations so that off-site property owners are not impacted to an unacceptable degree, especially those in off-site properties in Sections 28 and 29, which are drained by those reaches of CD-4 and FRC-A that contribute flow onto the designated wetland mitigation site. Based upon their locations, these properties would contribute flow mostly to the mitigation site parcels on Sections 32 and 33. The proposed surface water inflow to the U. S. Steel parcels in Section 28 would require inundation of minor portions of properties on Sections 28 and 29. A review of the most recent aerial photographs and topographic maps does not reveal any domiciles and other structures located on these properties at an elevation less than 1230 feet (NAVD88 for all referenced elevations below). However, there are potential inundation topics to be considered and are discussed below (refer to Figure 5 - Adjacent Property Owners Map):

1. There is a forested parcel (*i.e.*, the 160-acre SE quadrant of Section 29 plus the 40-acre SE quadrant of the SW quadrant of Section 29) drained by several ditches via CD-4 and FRC-A. With an average elevation of approximately 1226 feet and with the current proposed spillway elevation height of approximately 1226.5 feet on Sections 32 and 33 mitigation parcels, minor upstream inundation increase would be expected before the water level would reach the design spillway elevation of 1226.5 feet, thus halting inundation as the excess water spills into the ditch. This property is completely vegetated with no farming or dwellings. The potential minor increase of inundation would only occur during severe wet years so off-site impacts are negligible with a spill design elevation of 1226.5 feet. But because the parcel is drained by county ditches, the county would need to approve the partial ditch abandonment before this would occur.

Also based on a north/south flow analyses of this portion of ditch CD-4, separating the southern halves of Sections 28 and 29) and lies between the above-noted 160-acre off-site property and the mitigation parcel in Section 28, it is unlikely the current proposed design modification on the Section 28 parcel would have any impacts on any land owner.

2. The proposed changes to the mitigation site parcel in Section 28 involve adding berms to prevent the loss of run-off. The proposed design will create two basins, one in the eastern half of the parcel and one in the western half. The eastern and western basins would have separate inflow sources, Ditch 8 (plus a minor amount from Ditch I) and Ditch Y, respectively.

The basins would remain separate until the water level in one of them (either the east or west basin) reaches approximately 1227 feet elevation, at which point, the first inundated basin would begin to flow into the second basin. The lowest point in the peripheral berm is approximately 1225 feet and is approximately 400 feet from the northwest corner of the parcel. Surface water can be made to run onto this mitigation parcel by abandoning the west end of the ditch on the parcel's northern side.

However, this east/west portion of Ditch Y is actually on private property (NW quadrant of the SW quadrant of Section 28) and would require obtaining off-site property owner's permission before abandonment could be approved. Because the ditch section is not part of the U. S. Steel property, this portion of ditch section is not proposed to be abandoned.

Since the western end of the east/west portion of Ditch Y would have to remain open, the parcel's western basin would only receive surface-water inflow during times of high water/precipitation, when the water levels in Section 32 and 33 are at approximately 1225 feet or above.

Under normal circumstances (i.e., normal precipitation), the water level should not rise above the spillway elevation (approximately 1226.5 feet) of the parcels on Sections 32 and 33. However, should a wettest year storm event occur, this approximately 1226.5 feet spillway elevation could begin to impact several undeveloped properties to the east. Some off-site properties may have 20 to 40 percent of their property inundated, depending on the fill level of the on-site water storage during that month. Again, the adjacent properties are currently undeveloped so no impact would occur to farming or any dwellings. Even further east, the McClelland property has a farmed area at slightly higher elevations, and would have little or no inundation impacts if the spillway elevation is set at approximately 1226.5 feet. Also, there would be no spilling over into the eastern basin under this design scenario.

3. The study included the scenario with ditch abandonment at the western end of the east/west portion of Ditch Y. This scenario indicated that the water level could rise to the proposed spillway on the Section 28 mitigation site property (1228 feet elevation), which could inundate approximately 40 to 60 percent of the eastern properties noted above. And again, these properties do not currently have any structures and vegetated with trees and shrubs. At this water elevation of 1228 feet, approximately 10 to 30 percent of the southernmost 40 acres of the farmed property on Section 28 also would be inundated.

Water on Section 28 would start to spill over from the western basin into the eastern basin at an approximate elevation of 1227 feet. If the inflow is sustained until the water level in the western basin reaches the spillway elevation, the basins will reach a condition of steady state with the eastern basin at a slightly higher elevation (approximately 1228 feet) than the spillway due to the inflow from Ditch 8. At this point, the principal connection between the two basins would be approximately 300 feet wide, so the elevation difference between them is not expected to be significant. The water levels upstream, in off-site portions of Section 28, would be approximately a foot higher than would be the case with Ditch Y open, and the water level is not expected to much exceed 1228 feet. Based upon the 2010 site survey, the LIDAR data, and USGS topographic mapping, it is believed that up stream of eastern half of the Section 28 mitigation parcel, the elevation is sufficiently great (1228 feet or more) along the banks of Ditch 8. Therefore, as designed, inundating the eastern basin to approximately 1228 feet probably would not result in any significant inundation to any adjacent properties. Because of this and the fact that this is private property, the mitigation plan design does not propose to abandon the western end of the east/west portion of Ditch Y.

4. The proposed changes to the eastern half of the mitigation site parcel in Section 28 include removing Ditch 8/I that flows between the SE and SW quadrants of the SE quadrant of the section. This would allow off-site drainage from higher, off-site areas of Section 28 area to enter the eastern half of the U. S. Steel parcel via Ditch 8. Ditch J would also be removed to allow the surface water to be contained. If the inflow is sustained, it would be contained in the eastern basin until the water level reached an elevation of approximately 1227 feet, at which point, it would spill over into the basin in the western half of the parcel. Since the western end of the east/west portion of

Ditch Y will not be blocked, very little flow enters the western basin from the off-site north/south portion of Ditch Y. The overflow from the eastern basin would fill the western basin until the water level in the latter reaches an elevation of 1225 feet and would then spill into Ditch Y, preventing any further water level increase in either basin. The level in the eastern basin would remain 1227 feet. If Ditch Y is blocked, and very little flow enters the parcel through Ditch Y, but a significant amount enters via Ditch 8, then the overflow will continue until the spillway elevation (1228 feet) is reached and the offsite conditions are the same as discussed above where the inflow from Ditch Y could be significant, though most adjacent parcels are fully vegetated wetlands (except for the farmed properties noted previously) and that can be seen on the aerial map at Figure 5, showing the adjacent property owners.

5. No surface water inflow capture is proposed for U. S. Steel parcels in Sections 27 and 34 because the parcels are generally higher than the surrounding properties. In addition, while the proposed modifications on these parcels involve only constructing berms to retain run-off, the peripheral ditches that drain Section 27 must be allowed to flow at their present capacity so that the frequency of inundation of adjacent farmed properties will not increase. This is primarily due to the property to the northeast of the project site, which appears to have an active agricultural field (and dwelling) that drains on the south and west sides to Ditch B and in the northwest corner to Ditch A. Ditch A is relatively much deeper than Ditch B and may be important for lowering the current water table, in addition to intercepting surface-water flow. In order for the ditches around this property to continue to operate as at present, the downstream ditches that receive water from this property must also remain as they are, so the current mitigation design plan does not interfere with these current ditch flows. This would include Ditches B/F and B/F/G, which receive flow from Ditch B, and Ditch A/C/D/J, which receives flow from Ditch A (through culverts C10 and C4), as well as the ditch on the south side of the north half of Section 33, which receives drainage from both B/F/G (through culvert C6) and A/C/D/J (through culvert C5), respectively.
6. Other properties in Sections 27 and 34 that might be affected by partial ditch abandonment would include the forested south half of the 80-acre property on the west half of the northwest quadrant of Section 27, the 80-acre forested area on the west halves of the two properties that occupy the SE quadrant of Section 27, and the rectangular 40-acre strip property to the north of the wheat field in the NE quadrant of

Section 34. All of these parcels are forested and minor inundation due to abandonment of peripheral ditches, would not be a concern.

Ditch Flow Measurements

In order to better understand the relationship between recharge and the amount of flow in the ditches on the wetlands mitigation site, the response of baseflow to hydraulic heads on the parcels, and to provide baseflow estimates for use in aquifer modeling, the rates of surface-water flow were measured at specific times and at selected points in the ditch system

The rates of surface-water flow and channel widths were measured on four occurrences: June 1-3, June 17, July 13, and September 1-2, 2011. The following information was obtained:

1. Based upon observations made at ditch gauges in the mitigation site ditches in 2011, the upstream ditches are seasonally losing or gaining, with the amount losing water increasing throughout the growing season.
2. In general, the more downstream measuring points do not indicate a systematic accumulation of flow, even in spring.
3. The discharge rate measured between points in the main channel in many cases appears to decrease in the downstream direction (some consistently), even with inflow from tributaries entering between them, which strongly indicates that the ditches themselves are losing flow either continuously or at least in many locations.
4. Based upon field observations, flow increases quickly after recharge events and appears to recede slowly, but there are insufficient data/measurements to quantify this observation.
5. Based upon field observations, certain first-order channels appear to be stagnant most of the time, even when channels draining only a few times more area are flowing quickly. This is an indication that a significant amount of the recharge leaves the site as ground-water seepage, which bypasses the drainage system by draining downward toward the water supply aquifer and not leaving as baseflow to ditches.

The losing-ditch condition is incompatible in the long term with the higher heads measured in the centers of all of the mitigation site parcels. The condition is therefore transient and probably due to the lower-than-normal precipitation received in 2011. That is, surface water inflow in ditches that enters the site from upstream areas, baseflow from locations on the site

where the streams are still gaining, and runoff from the frequent, small precipitation events provide flow in the higher-order ditches, which continually (but gradually) lose water to the aquifer as they flow downstream. During years with more normal precipitation, the ditches are probably entirely gaining water, or almost entirely. It appears that there must be a delicate balance between the receding water table and the partition of flow into ditches versus downward through the confining unit. Some sense of this balance is necessary in order to predict the long-term average water levels, which are critical for the establishment of wetlands on the mitigation site and to predict the impacts off site. We chose to address these concerns through numerical ground-water flow modeling, which is described below.

Ground-Water Flow Modeling

The primary purpose of the ground-water flow modeling, using a computer application, was to:

1. Provide a means of confirming the conceptual model of the complex hydro-geologic system present at the mitigation site and surrounding U. S. Steel property;
2. Demonstrate that the water budget is conservative;
3. Provide a means of estimating the changes in hydraulic head that the proposed site modifications may be expected to affect; and
4. Provide insights that might inform recommendations for adaptive management of the mitigation site.

The model was framed based upon the known stratigraphy and hydrogeologic boundaries of the region, using the hydraulic testing results and water-level and ditch-flow observations made on the site.

Recharge rates were determined for individual parcels on the mitigation site based upon the precipitation, evapotranspiration, run-off, and infiltration (abstraction) rates estimated for the water budget in the Wetlands Mitigation Report. These, in turn, were based upon day-to-day precipitation and temperature measurements made at recording stations at Aitkin and McGregor, Minnesota and on the soil mapping and soil-hydrologic-unit designations and soils maps developed by the USDA Natural Resources Conservation Service.

Calibration against water levels measured on the site in 2010 and 2011 required that some of the outflows leave the U.S. Steel property by another route than through the drainage ditches.

Fortunately, 2011 was an uncommonly dry year and the development of losing stream reaches during the growing season made the significant of addition means of outflow obvious.

When the model considered the silty clay unit at approximately 20 feet below the surface to be an impervious boundary, the hydraulic gradient was orders of magnitude steeper than observed and the hydraulic heads were far above the ground surface. When the lower aquifers and confining units were added (based upon the stratigraphy recorded in the logs of nearby domestic wells) and hydraulic conductivities assigned commensurate with local domestic well testing for the sands and literature values for the silty clay confining units, the heads and gradients immediately then dropped into more credible ranges.

Additional calibration to observed site water levels required dividing some of the shallower layers into upper and lower units to accommodate places where the shallow aquifer was closer to the surface (*i.e.*, in the vicinity southwest corner of the northern half of Section 33) and the lower elevation of the drainage ditch in the western portion of the property, and the presence of open water on the ground surface in the proposed site modification alternatives along with the berms needed to control its movement.

Being satisfied that the level of calibration was adequate, the model was tested as to whether the water budget was sufficiently conservative and to simulate the effects of the proposed changes to allow full restoration of wetlands hydrology on the mitigation site.

Two alternative water-retention scenarios were simulated. Both involved the removal of the county ditches segments and the road that divide the mitigation site parcels in the northern halves of Sections 32 and 33 and the construction of berms just inside of the peripheral ditches surrounding the combined parcels in those sections as well as the other mitigation site parcels in sections 27, 28, and 34, in addition to the removal of certain private ditches in those sections. The specific ditch segments that were simulated as removed are Ditch C in Section 27 and Ditches 8, I, J, and portions of Ditch Y in Section 28. The difference between the two scenarios involved the treatment of east/west-orient portion of Ditch Y, which is the peripheral ditch on the north side of the western have of the mitigation site parcel in Section 28.

In Scenario 1, Ditch Y, which flows along the northern and western edges of the mitigation site parcel in Section 28, is left in the current condition. Upon leaving Section 28, flow in the ditch joins that from Ditch K and passes through Culvert C2 and upon emerging from the culvert, flows south along the western edge of Section 33. Since the county drains between the northern halves of Sections 32 and 33 are simulated as having been removed, the drainage

from Ditch Y would become run-on to the combined parcels in Sections 32 and 33 and the simulation accordingly adds it to the recharge in the portion of the combined parcel in the vicinity of the outfall. The simulated combined parcel also receives surface-water inflow from offsite through Culvert C1. The parcel in Section 28 also receives run-on via the off-site portion of Ditch 8 and the simulation adds its drainage to the recharge in the vicinity of the outfall, which would be located in the eastern half of the parcel.

In Scenario 2, the segment of Ditch Y along the northern edge of the mitigation site parcel in Section 28 is blocked at its western end and its discharge is diverted to an outfall in the western half of Section 28. All other aspects of the simulation are the same as in Scenario 1.

There are other private ditches that may be considered for abandonment on the mitigation site that do not receive water from offsite and do not involve utility easements or the county ditch system. These include Ditch X on Section 32, and Ditches E and Z on Section 34. In addition, Ditch F on Section 34 is entirely on the mitigation site and although it receives runoff from directly across the property line, it drains a wooded area that is already rather wet, so little offsite impact would be expected from abandoning this ditch.

The results of the two simulated scenarios indicate that the berms and ditch abandonment would cause the water table to rise to the point where certain parcels would be partly inundated and that the amount of water level rise is sensitive to both methods of water retention.

In some cases, the water budget may have overestimated the groundwater outflow because the water levels in some parcels rise to the spillway elevation. This means that the water levels would be amenable to adaptive management. This is important because the amount of inundation, both on the site and on upstream properties, can be controlled by adjusting the elevations of berm spillways. The implementation of selective ditch abandonment in future years would be supportive, considering the potential of increased evapotranspiration after the first couple years of wetland development.

In summary, the site's former hydrology can be restored by ditch abandonment to increase hydraulic resistance and thereby retaining sufficient water throughout the year. The berms also will greatly increase the hydraulic resistance on individual parcels, which would be sufficient to restore the wetland even where some of the peripheral ditches must remain open. If further increases in water levels are required, additional ditch abandonments in Sections 28, 32, 33, and 34 can be performed as many private ditches are on the site.

Conclusions and Recommendations

1. Many of the drainage ditches on the site are under the jurisdiction of the County ditch authority, as they have oversight on most of the drainage flows through the site. But vital ditch sections that control much of the site hydrology are private and under U. S. Steel's ultimate control.
2. On most parcels, a significant amount of water is currently lost from surface run-off into the ditches. Adding berms to retain this run-off will significantly increase water storage and increase hydraulic resistance on the mitigation site.
3. Capturing upstream run-off from off-site areas would provide an important amount of water storage to downstream parcels on the mitigation site, but retention of all surface water in-flow to some parcels could mean some minor to moderate inundation of adjacent parcels.
4. Elsewhere on the mitigation site, such as Section 27 and Section 34, the parcels are too far upstream in the drainage system to benefit from the retention of off-site run-on. The berms themselves should be sufficient to support hydrophytic vegetation.
5. Abandoning all peripheral ditches would maximize water storage and increase hydraulic resistance significantly, but this would not be feasible (in the short-term) since the project must consider potential impacts to offsite properties and also may not be approved by the County. The effectiveness of county ditches and some private ditches should be maintained, but that does not preclude abandonment of selected ditches (especially with the numerous private ditches), thereby assuring the additional hydrology for the designed wetlands.
6. It is recommended certain drainage ditches draining the farmed property to the north in Section 27 be allowed to continue under their current configuration. Even though sections of these ditches are private and may be abandoned without ditch-authority approval, the estimated hydrological conditions would not require their immediate abandonment. Should adaptive management become necessary, this option to safeguard the wetlands being established on the mitigation site could be enacted at any time if and when deemed necessary.
7. The current design considers blocking Ditch Y near the northwest corner of the U. S. Steel parcel in Section 28, (where it is part of CD-4). But this has the potential to retain water reaching the proposed spillway elevation of approximately 1228 feet, at which point, during the wettest years and possibly even average years, could inundate the southern

portions of three properties north of the mitigation site. This 1228-foot spillway elevation can be easily lowered at a later date if the receiving mitigation parcel demonstrates sufficient hydrology in dry years.

8. The proposed approximate 1226.5-foot spillway elevations in the current mitigation design for the site parcels in Sections 32 and 33, consider surface-water inflows that could result in water levels reaching the proposed 1226.5 feet spillway elevation. This would possibly inundate a portion of an off-site wetland forest (in Section 29) immediately north of the mitigation site parcel in Section 32.
9. The groundwater model, calibrated to 2011 water levels, using average annual recharge rates indicates that the proposed berm heights are expected to be sufficient to effect inundation of the mitigation site parcels up to their spillway elevations, occasionally even in normal precipitation years. In the event that it becomes necessary, the frequency and extent of inundation on adjacent properties can be easily be manipulated by lowering the spillway elevations.

Based on the discussions above, the current mitigation design maximizes the capture of precipitation and increases water storage (and soil saturation) to a suitable level for the entire mitigation project site.