TECHNICAL REPORT

FOR THE

ORDINARY HIGH WATER MARK DELINEATION

OF THE

YELLOWSTONE RIVER
AND
MISSOURI RIVER
(FROM ND/MT BORDER TO WILLISTON, ND)

IN WESTERN NORTH DAKOTA

NOVEMBER 2010

Prepared for:
STATE OF NORTH DAKOTA

Prepared by:

BARTLETT & WEST

&

McCain and Associates. Inc.

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FOR THE
NORTH DAKOTA STATE LAND DEPARTMENT
&
NORTH DAKOTA OFFICE OF THE STATE ENGINEER

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II. PROJECT DESCRIPTION

The State of North Dakota acting through the ND State Land Department (SLD) and the ND Office of the State Engineer (OSE) in December 2008 requested and entered into a contract with Bartlett & West, Inc. (BW) for the purpose of identifying and delineating the Ordinary High Water Mark (OHWM) on both sides of the entire Yellowstone River in North Dakota, and the Missouri River from the North Dakota/Montana Border to river mile #1549 near Williston, ND. BW hired McCain & Associates as the main ecologist and field delineators for the Project. After the OHWM line was established, the final component of the Project was to calculate the acreage below and above the OHWM line for each quarter section in which the two rivers reside within the Project area.

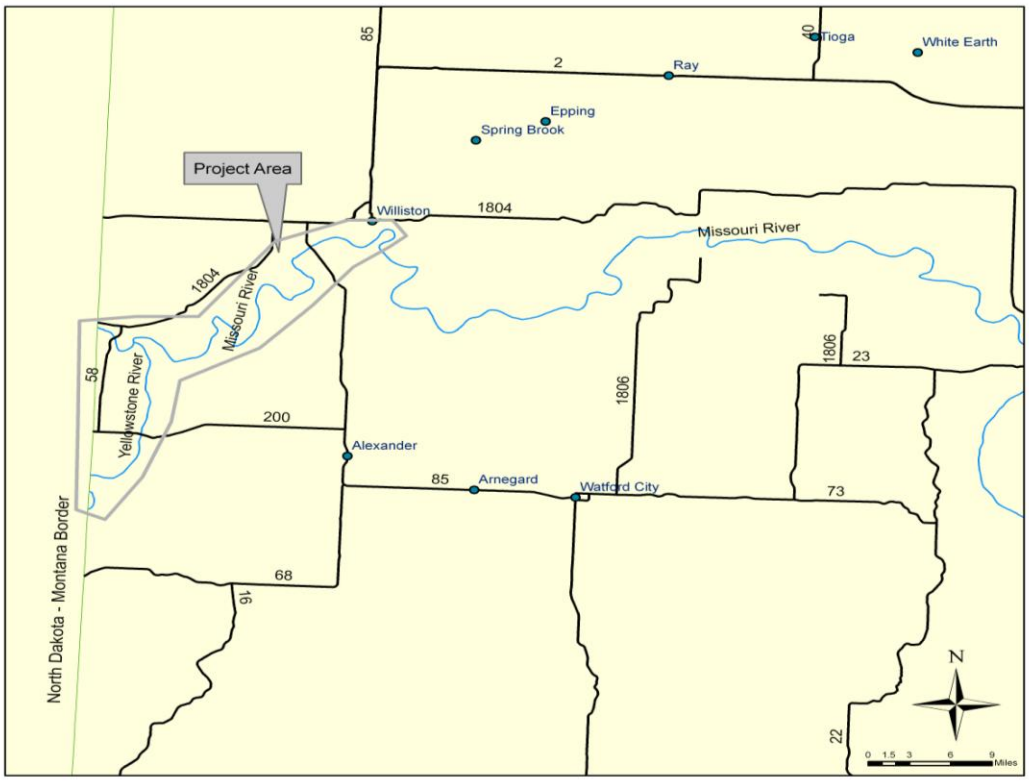


Figure 1. *Location map depicting the general project area.*

The total length of the Project is approximately 57 miles, with 18 miles delineated on the Yellowstone River, 33 miles on the Missouri River, and 6 miles on the Trenton Loop portion of the Missouri River. The field assessment work commenced in May of 2009 and was initially completed in September of 2009. There were two additional field visits that were needed in October/November of 2009 for final verifications and OHWM line modifications. There was also a work stoppage in June to early-July due to the high flows encountered on the Yellowstone River which was a result of the mountain snow-pack spring melt runoff. During the work stoppage, the flows were at or above the presumed normal high flows, and it was agreed to cease delineation work until the

water levels subsided. Once the river flows returned to near normal conditions, the crew remobilized and the field work resumed.

III. BACKGROUND

The OHWM is a legal definition of a physical feature found on the landscape. However, since most rivers are dynamic the location of their channels can meander and therefore, the OHWM can fluctuate over time. Over a period of years the OHWM can move, sometimes suddenly and abruptly (avulsion), but often times it moves more slowly and subtly (accretion). This project was completed with the understanding that this was a snapshot of the current OHWM for these two river systems as existed in the summer/fall of 2009. The OHWM is a transition zone between the aquatic and terrestrial environments. In some instances this transition occurs in a narrow stretch such as along a steep embankment that can be easily identified. In other cases, it can be a broad and gradual change, such as one would find on an alluvial plain, which can be difficult to interpret and requires a detailed and intensive onsite ecological review. The work completed under this contract was to delineate the OHWM and is not a final legal determination as to whether any specific property is "sovereign land".

As defined in the North Dakota Administrative Code *(NDAC 89-10-01-03)*, Ordinary High Water Mark means "that line below which the action of the water is frequent enough either to prevent the growth of vegetation or to restrict its growth to predominantly wetland species. Islands in navigable streams and waters are considered to be below the ordinary high watermark in their entirety." For this Project, "…predominantly wetland species…" meant that greater than 50% of the vegetation was composed of wetland species under the methodologies established by the "*Ordinary High Water Mark Delineation Guidelines"* published by the ND OSE in 2007.

The North Dakota Supreme Court (*State ex rel. Sprynczynatyk v. Mills, 1999 ND 75, ¶ 13, 592 N.W.2d 59)* has further defined "high water mark" as: "[w]hat its language imports - a water mark. It is co-ordinate with the limit of the bed of water, and that only is to be considered the bed which the water occupies sufficiently long and continuously to wrest it from vegetation, and destroy its value for agricultural purposes. In some places, however, where the banks are low and flat, the water does not impress on the soil any well-defined line of demarcation between the bed and the banks. In such cases the effect of the water upon vegetation must be the principal test in determining the location of high water mark as a line between the riparian owner and the public. It is the point up to which the presence of action of the water is so continuous as to destroy the value of the land for agricultural purposes by preventing the growth of vegetation, constituting what may be termed an ordinary agricultural crop." Areas below the OHWM may have vegetation suitable for grazing but wetland vegetation capable of being grazed is not an "ordinary agricultural crop".

In 2007, the ND OSE, the North Dakota State office that regulates the state's sovereign lands, published the "*Ordinary High Water Mark Delineation Guidelines*". During this Project the delineation team conducted OHWM delineations in compliance of these Guidelines. This project was an ecological study of 612 transects along 57 miles of river that was completed in a relatively short timeframe. We are not aware of any other OHWM delineation project of this magnitude that has been completed or published.

IV. METHODOLOGIES

There were many components necessary to complete this Project. This portion of the report will describe the methods used in those various components, including the field assessment, hydrologic analysis, and the GIS Database. As mentioned previously, the methods used were in accordance with the guidelines published by the Office of the State Engineer. The basic intent of the field assessment is to develop and follow an orderly approach to making an OHWM determination. The method described below ultimately relies on a series of individual OHWM points delineated at each transect location. The delineation team then used their hydrologic and vegetative experience and knowledge gained in the field assessment to connect these points to establish a defensible OHWM line utilizing 2009 aerial photography. Finally, using this line, the acreages below and above the line were calculated using GIS based software.

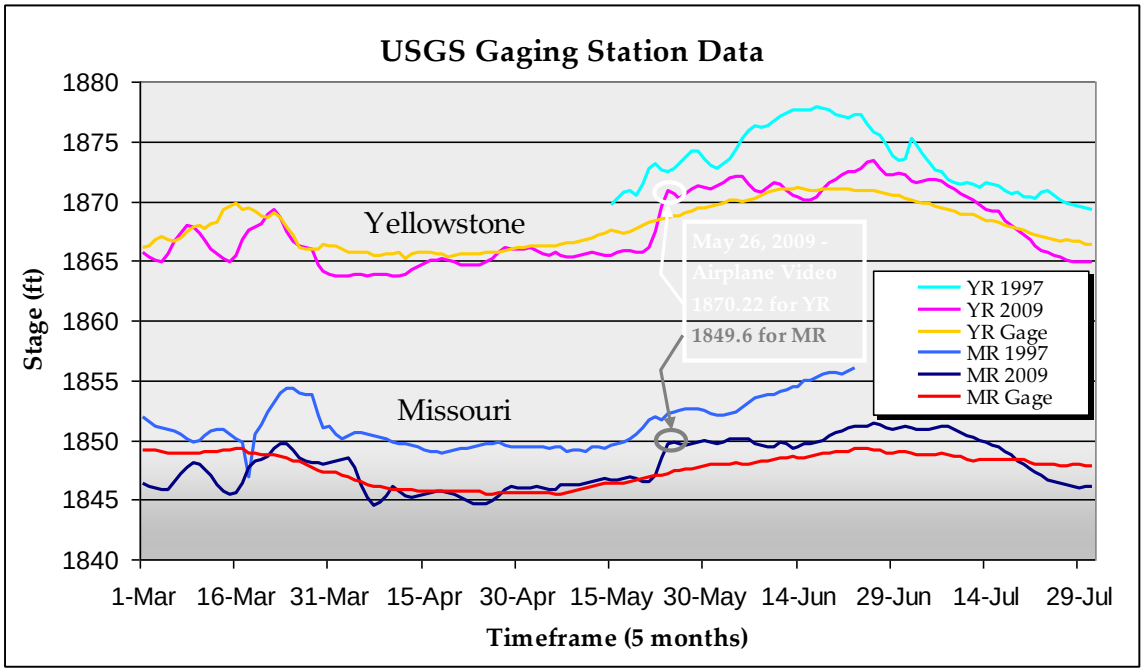
A. Hydrologic Assessment

A hydrologic assessment of high river flow characteristics is one of several accepted indicators used for OHWM delineations in North Dakota and one was completed for this project. There are current and historic USGS stream gage data available for both rivers within the project area, which made the hydrologic analysis somewhat easier. The ND OHWM Delineation Guidelines do not indicate a specific recurrence interval, therefore a statistical analysis was not completed. As a simple reference, the OHWM in a riverine environment can typically be found near the average high flow elevation and should always be lower than the peak flood event elevation.

An analysis of the hydrologic data for average ordinary high water events and elevations provided the field delineators with another tool to assist in making their delineations. Several times during the field delineation the current daily stream gage reading was relayed to the field delineators and compared to the OHWM elevation measured in the field for that particular stretch of the river. The difference in the two elevations would provide the field team with a vertical reference point.

Two gaging stations were utilized during the project. The Cartwright gage on the Yellowstone River in Section 35, T151N R104W, near the Highway 200 bridge, and the Williston gage on Missouri River in Section 6, T153N R101W near the Highway 85 bridge. Both gages have daily stage data that is referenced to a known datum. The

following graph depicts water surface elevations over a 5-month period from March 1st – July 31st, which is typically when the higher water surface elevations are observed.



The three lines depicted for each river are for the project year 2009, a higher flood year 1997, and then the long term daily average for the period of record, which is 1958-2008 for the Yellowstone River and 1965-2002 for the Missouri River. Also depicted on the graph is the date (May 26, 2009) that a member of the delineation team and the State were able to make a reconnaissance trip in an airplane and capture aerial video and photographs of the two river systems during the spring rise. As one can see, the timing of the flight was right in line with the high average flow for both rivers. This additional information proved invaluable to the delineation team when making their final determinations.

From the graph one can depict the high average daily elevation for the Yellowstone River at Cartwright is approximately 1871 ft-msl (1929 vertical datum). In 2009, the flows in the month of June and into early July were higher than that, which was the reason for the suspension of the fieldwork during this time. The peak water surface elevation for this station, not influenced by ice jams, occurred in mid-June of 1997 with an elevation of 1877.8 ft-msl (1929 vertical datum).

By definition, the OHWM should fall somewhere between the high average elevation and the peak elevation, and likely closer to the high average elevation. Near the gaging station at Cartwright, the surveyed elevations of the OHWM delineation points ranged from 1874.2 – 1874.8 ft-msl (1988 vertical datum). If the data from the USGS is adjusted from the 1929 datum to the 1988 datum, which is +1.8 feet, this would raise the high

average elevation to 1872.8 ft-msl (1988 datum). This indicates that the surveyed OHWM elevations (1874.5 average) near the gaging station fall right in between the 1872.8 (average high) and the 1877.8 (1997 peak) elevations, but closer to the high average elevation.

While quantitative hydrologic analysis of data is appealing, it is by definition supportive of the field OWHM delineations. The most accurate analysis is provided by field delineators in conformance with the 2007 "*Ordinary High Water Mark Delineation Guidelines*".

The current stream gage data also provided the delineators information which allowed the team to assess the river conditions and determine if the delineation should continue. Because the delineation was occurring in late spring and early summer we knew there was a good chance that the delineators would encounter high water flows at one point or another. Once the Yellowstone River reached this higher level, the team decided that the flow was likely near the ordinary high and the field assessment was postponed until the water levels subsided. Once the field assessment resumed, this high water level was used as another indicator for the delineation (i.e. the high flows were likely near the OHWM). Following an analysis, it was determined that the spring runoff flows gauged for the Yellowstone River in 2009 proved to be greater than normal.

For the Missouri River gage at Williston, the high average daily elevation is 1849.3 (1929 vertical datum). There is a correction of +1.7 feet to convert to the 1988 vertical datum, which brings the elevation to an even 1851.0 ft-msl. The peak water surface elevation during the period of record occurred in June of 1997, with an elevation of 1856.1 ft-msl (1929 datum). Corrected to the 1988 vertical datum, it would be 1857.8 ft-msl. Similar to the Yellowstone, the OHWM elevations surveyed near the Missouri River gaging station ranged from 1852 –1853 ft-msl (1988 elevation). Once again the OHWM elevations fall between the high average of 1851 and the peak elevation of 1857.8, but much closer to the high average elevation.

B. Field Delineations

OHWM point delineations were conducted on a frequency that properly delineated the OHWM line within the project area. Prior to mobilizing the team to the field, the project stakeholders had an opportunity to review the predetermined OHWM delineation transect locations, and offer any guidance and suggested additions or deletions. The final transect and delineation points are depicted on the project maps which are a separate attachment to this report. The number of transects depicted on the maps was based on the agreed upon objective of no less than six (6) transects completed per mile on each side of the two river stretches and additional transects to be added, at the discretion of the delineation team, to properly identify the OHWM boundary line.

In order to facilitate the field assessment and maintain a tight schedule, it was decided to delineate the OHWM by accessing each transect location from the river by utilizing a boat and handheld GPS units. This allowed the delineation team to easily travel from one transect location to another and from one side of the river to the other. The 2007 "*Ordinary High Water Mark Delineation Guidelines*" state the OHWM delineation should begin on the uplands and proceed along a transect towards the water until the vegetation is predominantly wetland vegetation. By working from the water to the uplands rather than from the uplands to the water, it was imperative that the delineators traverse inland as far as necessary to properly delineate the OHWM, so as not to miss any back channels or backwater areas that could be below the OHWM.

Once this upper reach location was identified and accessed, the delineator then began working their way back to the river while identifying upland and wetland dominant vegetative species. As soon as the delineator identified the presumed OHWM boundary by locating the 50/50 transition point along the transect, the 1-meter by 1-meter quadrat was placed on the ground and the delineator could then begin filling out the delineation data form. A delineation data form was filled out for each OHWM point on each transect location. The delineator identified and recorded the dominant vegetative species and their percentage composition in the plant community, along with other features indicative of the OHWM including soil formation changes, erosion features, and sediment and wrack deposits. When necessary a Registered Professional Soil Classifier was on site to evaluate the soil properties and identify hydric soils.

Vegetation Sampling Procedure

Quadrat

The presence or lack of certain vegetative species was the primary tool used to locate the OHWM for this project. Canopy cover of existing vegetation is estimated using a 1 x1 meter quadrat. The quadrat is color-coded to indicate position relative to the river, i.e., blue side is always placed towards the river, the green side upland, the pink side upstream and the white side, downstream. Each side of the quadrat is marked in thirds to enable visualization of nine sub-quadrats (discussed below).

Transects perpendicular to and towards the river are traversed to identify the transition from predominantly upland vegetation to wetland vegetation. The quadrat is placed with the upper edge at the "line" between predominantly wetland vegetation and upland vegetation.

Vegetation Measurements

Plant species in each quadrat are categorized by strata as defined by the North Dakota State Engineer Ordinary High Water Mark Delineation Guidelines (2007). Species

dominance is measured as specified in the US Army Corp of Engineers (COE) 1987 guidelines (Table 1).

Table 1. Vegetation Strata and Dominance Measure

Strata	Definition	Measure to Determine Dominance
Tree	≥5 inches DBH[1] and >20 feet in height	Basal cover
Sapling	0.4-<5.0 inches DBH and >20 feet in height	Height
Shrub	Woody plants 3-20 feet in height, often multi-stemmed	Height
Herbaceous	Grasses, sedges, ferns, forbs and woody seedlings <3 feet in height	Cover
Woody Vine	Woody climbing plants, such as wild grape, etc.	Number of stems

[1]DBH is defined as diameter at breast height, where height is equal to 4.5 feet from the ground

Dominant species in each stratum within the quadrat is derived by estimating absolute cover. The 50/20 rule is then used to measure dominance within each stratum. Species within each stratum are ranked in descending order of cover, until the cumulative cover exceeded 50%. These species qualify as a dominant species. If additional species alone exceed 20% cover, they also qualify as a dominant species.

Dominant species are assigned indicator status as defined by the COE (1987). Total absolute cover of dominant species with indicator status of obligate wetland (OBL), facultative wetland (FACW), and facultative (FAC) plants are added to determine the percentage of dominant wetland species. The relative percentage of wetland to terrestrial vegetation is then calculated. Quadrats with >50% relative cover wetland species (OBL, FACW and FAC) is defined as predominantly wetland.

Weekly Sample Verification

To ensure both accuracy and precision, field delineation personnel met each week to review methodologies. Three quadrats were sampled to determine wetland dominance. Field personnel sampled each frame independently. Quadrats were marked into nine sub-quadrats and the percentage of wetland vegetation was estimated within each sub-sample. Quadrats in which five of nine sub-quadrats were dominated by OBL, FACW and FAC plants, were classified as wetland dominated. Sampling results were compared to ensure consistency in sampling procedures between individual delineators.

Plant Identification

Experienced field trained personnel identified the majority of plants on site. If unsure of species identification, a sample was collected and identified in the office before determining its indicator status. The *1988 National List of Plant Species that Occur in Wetlands* was also referenced to determine if the dominant plant was a wetland species.

C. Land Survey

Markers (wood stakes or lath) were placed where the OHWM delineation point was located for each transect in the project area, and the lath was labeled with the transect identifier which is explained on the next page. These markers will be left in the field for future detection, but there is a chance that the markers will be removed by the adjacent landowner, or be knocked down. If that is the case, they can be easily restored because each OHWM delineation point was surveyed using survey grade GPS equipment. The survey data is referenced to the '88 NAVD vertical datum to aid in a more refined elevation at each OHWM delineation point. These points are used as the foundational data from which the OHWM line is developed and they are provided as part of the overall GIS database. Additional "soft points" were taken with the GPS equipment as well as handheld GPS units. These points later assisted the delineation team when determining the location of the OHWM line between the surveyed OHWM delineation points.

For additional documentation and verification, five digital photographs with a resolution of six (6) megapixels were taken at each delineation point transect location; one facing upland (UP), one facing the river (R), one facing upstream (US), one facing downstream (DS), and one overhead of the 1-meter by 1-meter square quadrat (Q) placed on the ground at the OHWM delineation point. Most photographs were taken such that the stake, the transect identifier label, and quadrat location at the OHWM delineation point were also visible in each of the photographs. Electronic copies of these photographs along with the delineation data forms are included in the appendix of the report on a DVD disc and are organized according to the transect identifier.

Figure 2. *An example showing a typical downstream facing photo. The quadrat was painted with a separate color for each side. Pink was upstream, white was downstream, green was towards the upland and blue was towards the water.*

The transect identifiers are based on their general location starting with the river stretch, Y for the Yellowstone River and M for the Missouri River. Then the three-digit Township and three-digit Range, and the two-digit section. Lastly it ends with an L for the left bank or an R for the right bank and then the transect number. Left or right bank determination is based on a downstream facing orientation and the transect numbering begins when the river first enters that section and continues downstream until it enters the subsequent section. The following is an example label for the fifth transect on the left bank in Section 31 of Range 104 W and Township 150 N on the Yellowstone River:

Y15010431L5

D. GIS Database

A data model was developed to define how the collected field data would be represented and accessed in a digital format. The data model depicted the required data elements, relationships, and schema of spatial and tabular data. The data model was implemented in the form of a geodatabase, which is a database designed to store, query, and manipulate spatial and tabular data. The File Geodatabase (FGDB) was select from the various types of geodatabases for the "container" to maintain the collection of datasets associated with the OHWM delineation. FGDBs are stored as folders in a file system and are portable across operating systems.

Due to the related nature of the OHWM delineation data, a Feature Dataset was created within the FGDB to allow for more advanced GIS analysis. The data derived from OHWM delineation were categorized into collections of geographic features with the same geometry type and attributes, commonly known as Feature Classes. Three Feature Classes were developed within the FGDBs Feature Dataset, including:

Transect	
Geometry Type	Point
Attributes	Transect (PK): FieldTypeString Elevation: FieldTypeDouble Hyperlink: FieldTypeString

OHWM_Line	
Geometry Type	Polyline
Attributes	Waterway : FieldTypeString Transect1 : FieldTypeString Transect2 : FieldTypeString

PLSS_Quarters	
Geometry Type	Polygon
Attributes	Township: FieldTypeString Range: FieldTypeString SecNum: FieldTypeString Quarter: FieldTypeString OHWM: FieldTypeString Acres: FieldTypeDouble

The field-collected survey grade GPS readings were processed into features stored within the Transect Feature Class. Each Transect feature was attributed with an identifying reference number as well as the elevation. The five digital photographs taken in the field of each Transect, along with the scanned version of the field completed delineation data form, were merged into a single Portable Document Format (PDF) per individual Transect. The complete name of each PDF file was populated into the Hyperlink attribute of the Transect features to provide efficient access to the related documents.

E. OHWM Line Determination and Final Acreages

The first steps in creating the OHWM were described above, including the necessary field work. In order to determine the acreages above and below the OHWM, polygons must be created, and to form polygons, lines must be generated. One of the necessary lines is the one used to connect the OHWM delineation points, while the other is the Public Land Survey System (PLSS) data that identifies the quarter section boundaries. Together they will form the polygons that will be used to calculate the acreages.

In order to connect the OHWM points, several techniques and tools were utilized. One of them was using the soft points (both from handheld GPS units and survey grade units) that were collected while the field delineation team was in the field. These points were taken on occasion as the team was mobilizing from one OHWM delineation point to another. Delineation data forms and photos were not taken for these soft points.

Another very helpful tool utilized was the 2009 FSA National Agriculture Imagery Program (NAIP) aerial photography provided by the State. Using these high resolution aerial images, the delineation team was able to identify features such as cut banks, erosion areas, mud flats, and debris, as well as the vegetative species, including different types of trees, grasses, and willows that were used to delineate the OHWM in the field. Once the features were identified, we were able to connect the OHWM delineation points using GIS software, and create the line needed for the polygons.

Another tool used was the National Elevation Dataset (NED). The National Elevation Dataset (NED) is the primary elevation data product of the USGS. The NED is a seamless dataset with the best available raster elevation data of the conterminous United States. We symbolized this in two-foot intervals close to the river so we were able to identify the relief in this area, including the cut banks. We used this tool to identify elevations when we were connecting the delineation points, and to match as best we could with the 2009 aerial photography.

Also, we reviewed the delineation photographs taken in the field and the aerial video to assist in determining where the OHWM line should be placed according to certain features and vegetation identified in these photographs. Finally, for a few of the questionable areas we re-mobilized the delineation team to the field to collect additional data and to adjust the line according to what was identified in the 2009 aerial photos.

When the OHWM line was finalized internally it was placed on maps so the delineation team and the State could complete a final review and make any final adjustments. Once this line was finalized, the next steps involved the acreage determination. To identify the quarter sections, BW downloaded the BLM PLSS data from www.geocommunicator.gov . The layer was uploaded as quarter-quarters so they had to be merged into quarter sections. Once this was completed a query was run to identify the quarter sections that

were intersected by the OHWM line. Then a Construct Features tool was used to cut and extract the quarter sections that were located near the OHWM line. After the quarter sections were extracted the Calculate Geometry tool was used calculate the acreages for each polygon. The final step involved determining if the polygons were either above or below the OHWM line, and outputting the data into a spreadsheet so it can be easily referenced and utilized by the State.

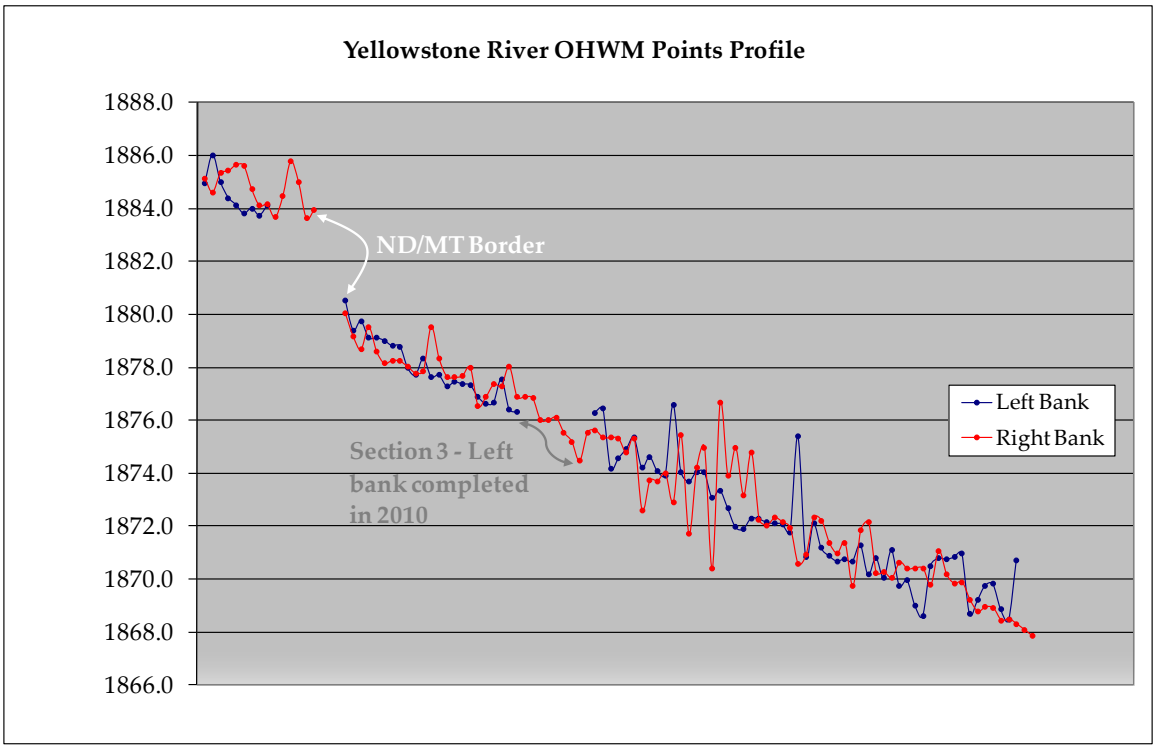
An Internet Mapping website was implemented to provide immediate access to the project data, as well as to assist in the coordination of field efforts. The website was developed using ESRI ArcGIS Server technology and utilizes user authentication to secure the site. The map includes the Feature Classes developed from the collected field data, as well as base map data. The base map consists of datasets depicting features which provide a point of reference for the project data including: BLM PLSS boundaries, USGS topographic maps, ESRI World Street Maps, National Agriculture Imagery Program (NAIP) county mosaics from 2006 and 2009, as well as many other datasets. Custom functionality was developed as part of the website to allow users to enter a transect reference number or a legal description. The custom function will then navigate the map to the location entered by the user. The website also includes a Hyperlink tool which provides access to the related field documents.

The developed FGDB containing the Transect, OHWM_Line, and PLSS_Quarters, along with the merged delineation data forms and field photos have been written to several DVD's and added to the appendix of this report. Paper maps depicting the datasets contained within the FGBD with 2009 NAIP imagery, parcel acreage maps, and a complete parcel listing will also be provided to the State for their use.

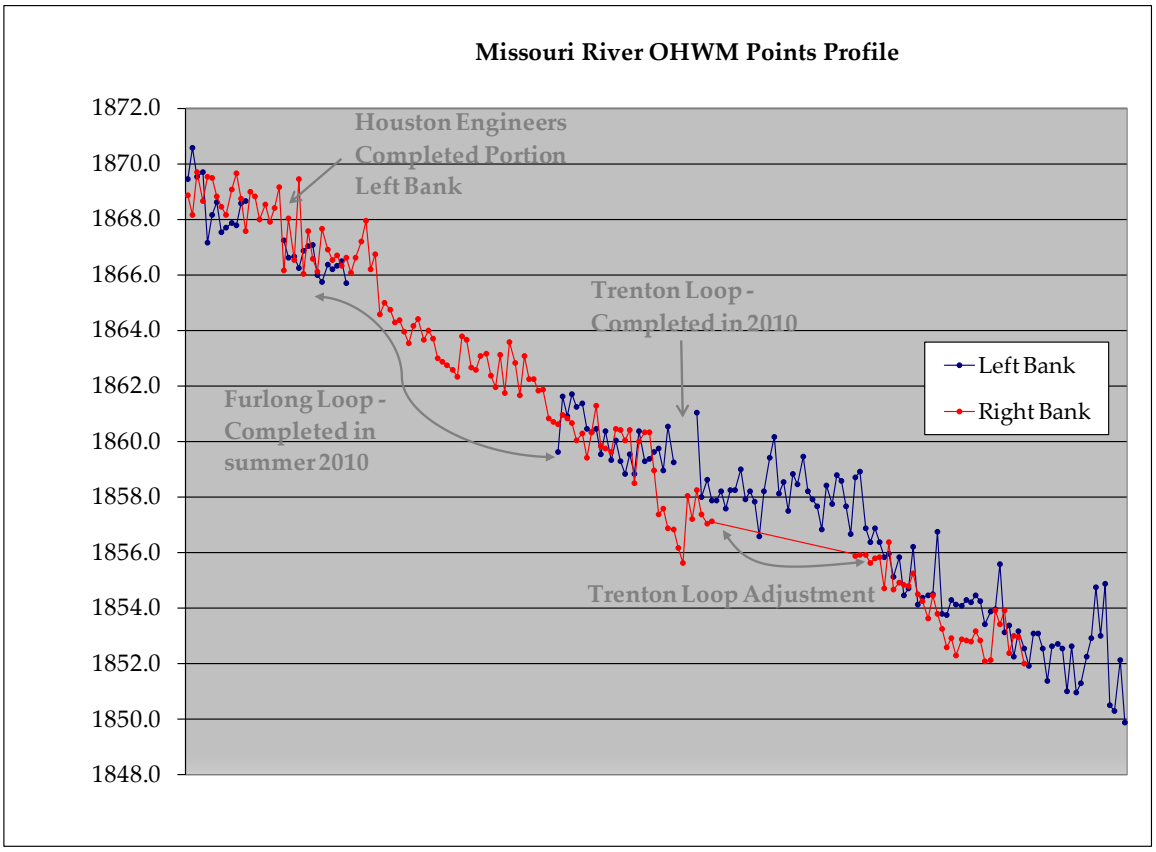
V. CONCLUSIONS AND FINDINGS

After nearly three months of field work, the delineation team surveyed a total 612 individual transects for both rivers, with 211 completed for the Yellowstone, and 401 for the Missouri. From this total, 500 transects were used in the final OHWM line determination, with 189 for the Yellowstone, and 311 for the Missouri. Due to backwater areas and braided streams, additional transects are not that uncommon in an OHWM delineation project.

As an additional reference check the delineation point elevations for the utilized points were placed in a spreadsheet and a profile was generated for each river connecting the individual OHWM points. The following two graphs depict this profile, and as one can see, the elevation points generally follow a uniform slope with a few outliers. One must be cognizant of the fact that elevations should only be used as a reference check. All of the elevations shown are Feet-Mean Sea Level and referenced to the NAVD 1988 Datum.

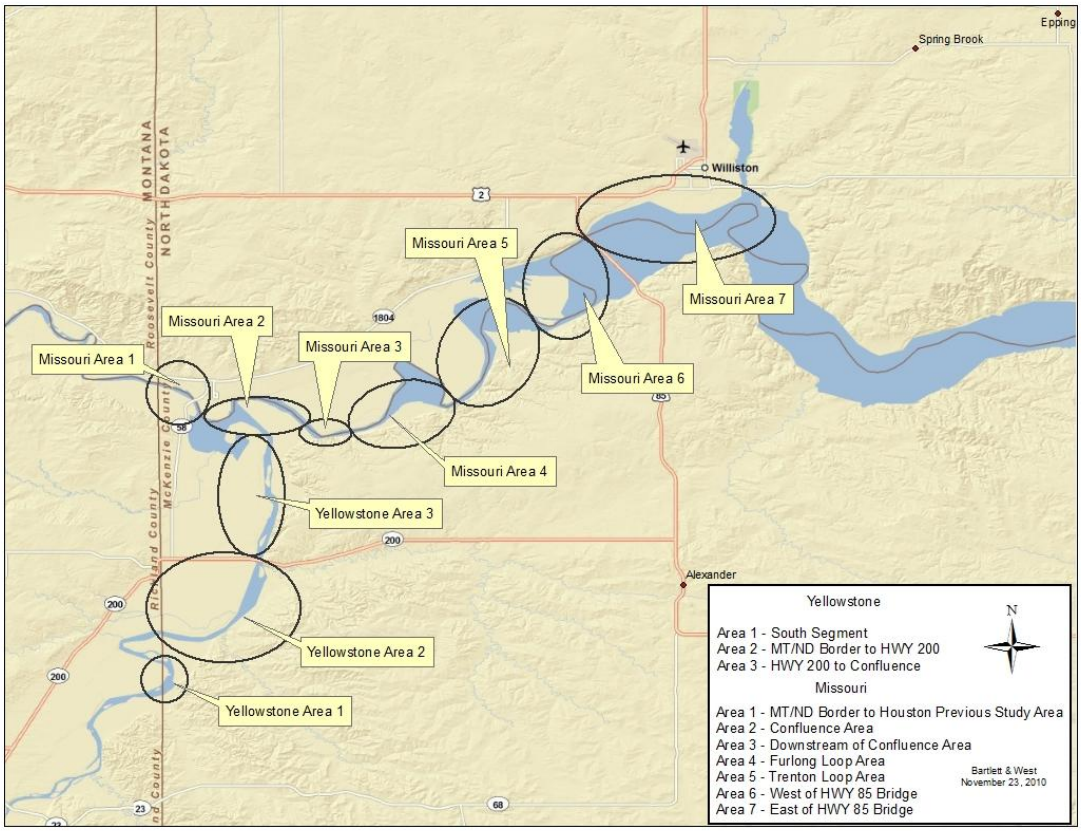


For the Yellowstone River, the reason for the big shift on the left side of the graph is that the profile begins in ND, but then the river flows back into MT for approximately 3.4 miles, before crossing the border back into ND. There are no points depicted for the MT portion of the river. There is also a stretch of river in Section 3 that will need to be completed in the summer of 2010, due to concerns that manmade features may be influencing the OHWM in this area.



For the Missouri River, the long gap on the left side of the graph is for the left bank portion near the Furlong loop in T152N R103W which was completed in summer of 2010. The other shift on the right side of the graph is so the right bank can be adjusted to account for the additional transects completed for the left bank of the Trenton Loop.

Below is a map that depicts the three delineated areas of the Yellowstone and seven delineated areas of the Missouri that was included in the Phase I delineation. These areas correspond to the area descriptions that follow in the report and on the maps.



1.0 YELLOWSTONE RIVER

Yellowstone River - South Segment (Area 1)

The present-day Yellowstone River enters North Dakota in Section 6, T149N, R104W, and Section 31, T150N, R104W. The river meanders to the north and west, and then exits North Dakota in Section 30 and the southwest corner of Section 19. The river then re-enters North Dakota in Section 18. Historically, at the time of statehood, this segment of the Yellowstone River extended into Montana with its western bank in Montana, and eastern bank in North Dakota. (*Sovereign Lands Background Report*, Alexis Duxbury, ND Game and Fish Department, March 2005).

Left Bank

Currently, the left (west) bank of the Yellowstone River is found on an old island that was documented in a 1910 survey as a high sandbar overgrown with willows on its southern end (Duxbury 2005). The 2009 survey extended into Montana to determine if there were presently any through channels remaining on the west side of the island. An

old channel inlet was found in along the north edge of Section 17, T23N, R60W. Smooth brome dominated this old inlet. An additional channel bed was observed in Section 8, T23N, R60W. Upland species adapted to sandy soils, including needle-and-thread, prairie sandreed, and fringed sage dominated this area. Farther east, in Section 31, T150N, R104W in North Dakota, an older channel was delineated and followed in a northeasterly direction. Wetland species dominate the south portion of the channel, but traveling northeast, the channel becomes narrower and eventually gives way to upland species including Kentucky bluegrass and Russian olive. This investigation concluded that the OHWM follows the channel but then it returns to the riverbank. Smooth brome, leafy spurge, Russian olive, and quack grass are the dominant species upland from the OHWM. Based on historical evidence, this OHWM delineates the old island edge. Near the east-west Section line between Sections 30 and 31, wetland vegetation extends up an old dozer trail and then returns to the bank edge. After the river meanders back into Montana, water "outlets" along the west bank were noted. Since evidence of an active water inlet was not found on the south side, it is assumed that these "outlets" extend into a backwater area in Montana.

Right Bank

As the Yellowstone enters North Dakota in Section 6, T149N, R104, the right bank of the river consists of a cut bank that is primarily barren of vegetation. This portion extends from North Dakota border to the northern edge of Section 32, T150N, R104W. Uplands above the riverbank are comprised of smooth brome and crested wheatgrass. The cut bank includes multiple shelves near the waterline and a nearly vertical cut adjacent to the uplands. The vertical cut ranges from 6-10 feet in height. Scattered patches of smooth brome are along the uppermost shelf (base of the vertical bank). Patches of wetland vegetation including sandbar willow, reed canary grass, and common scouring rush are sporadically located along the shelves of the bank. Seedling cottonwoods are common and primarily between the wetland vegetation and the upland vegetation.

Beginning at the northern edge of Section 32, T150N, R104W, and extending north into Section 30, T150N, R104W, the Yellowstone has a well-vegetated sloping bank. The upland edge of the riverbank has a dense growth of Russian olive and mature cotton-wood with smooth brome in open areas. A low (3-5 feet) near vertical cut separates the upland and sloping bank along the river. The upper portion of the sloping bank is predominantly upland vegetation that includes smooth brome, Russian thistle, and Russian olive. Below the bank, Emory's sedge is dominant. The OHWM is located along the upper edge of the sloped bank above the wetland (Emory's sedge dominated) vegetation.

Yellowstone River - Montana border to Highway 200 Bridge (Area 2)

The Yellowstone River re-enters Montana and meanders back into North Dakota in the southern portion of Section 18, T150N, R104W, traveling easterly for approximately two and half miles before diverting northwest in Section 16.

Left Bank

The left bank is a nearly vertical cut ranging from two to twelve feet from the Montana border to Y15010416L4. This portion of the river has been "rip-rapped" with old machinery, cars, and like materials. Weedy species are common on the cut bank. Above the OHWM, smooth brome and crested wheatgrass are the common upland dominants. From Y15010417L6 to just past Y15010416L2, a narrow band of Peachleaf willow, cottonwood and sandbar willow are above the OHWM.

From Y15010416L5, north to Y15010410L6, the left bank of the Yellowstone is actively eroding and slumping. Evidence suggests that the river in this area was situated farther west at one time (sandy structure, natural levee formation, vegetation lines parallel to the river). In Section 10, T150N, R104W, a cut in the bank was followed and a channel was found in a re-inventory in November of 2009 after a study of 2009 aerial photography. Initially, the OHWM transect Y15010410L5 was placed along the river edge. Evidence of river inflow and wetland vegetation north of Y15010410L4 was found and a channel was followed from the bank towards the northeast and leading to Y15010410L6. Reed canary grass and willows dominate the channel. Sandbar willow is more dominant from the channel to the riverbank. From transect Y15010410L6, north to Y15010403L2, the OHWM follows along the water edge.

Upland from Y15010403L1 and Y15010403L2, Russian olive, smooth brome and a cultivated fallow field are located adjacent to the OHWM. A small band of wetland vegetation is continuous along the western (upland) edge of the fallow field. At the north end of the cropland area, a berm, or dike approximately three feet high has been constructed to impede water flow. Due to these conditions encountered, it was determined that this area warranted further investigation and this was to be completed in the summer of 2010.

Between Y15010403L1 and north to Y15110434L2, there are no apparent river inlets; however, wetland vegetation is present in a backwater channel. The channel extends from Section 34, south to the berm located at the north end of the cultivated field in the S½ of Section 3. The channel is wide in the north portion but becomes very narrow by the time it reaches the berm. Reed canary grass is the predominant cover in the channel. In several areas, open stands of reed canary grass are common in the understory between the backwater channel and the river. There was no evidence of any through connections between the river channel and the backwater channel. Russian olive is common in the area, although more open in areas with reed canary grass. At the south edge of Section 34, a constructed high river access trail blocks natural flow through the area. A culvert under the access allows a continuation of backflow into Section 3 from Section 34 (Figure 3). North of the river access (Section 34), is a continuous dominance of wetland vegetation caused by back flow from a north inlet. OHWM transect Y15110434L3 lies just north of this point along the river channel.

North of Y15110434L3 the bank is steep and has been rip-rapped north to the boat ramp at Sunheim Park. The majority of the upland in Section 34 is tilled annual cropland. At Sunheim Park sandy beaches with sandbar willows are found to the Highway bridge.

Right Bank

As the river enters North Dakota, the right bank is a nearly vertical cut ranging from two to five feet. It appears (McKenzie County aerial photograph 2009) a channel was once behind the OHWM. Above the OHWM smooth brome is common to dominant. Older cottonwood trees with scattered Russian olive are common above, often setback 75 feet from the river edge. Cultivated fields are behind the wooded area. The river channel curves southeasterly in Section 21 around an island. Cottonwood and Peachleaf willow are above the OHWM, although no active channel observed. The wooded area narrows farther north into Section 16.

From Y15010416R2 to the north edge of Section 15 near Y15010415R3 the river edge is a steep cut bank. Upland areas are predominantly introduced species. Perennial species including crested wheatgrass and smooth brome are near the river with annual cultivated fields on the adjacent uplands. The cut bank includes multiple shelves near the waterline and a nearly vertical cut approximately 6-10 feet in height. Slumping banks have caused some deposition of smooth brome grass sod below the OHWM. The riverbank is barren with occasional patches of quack grass, sandbar willow and Emory's sedge.

In the north portion of Section 11 and in Section 2, T150N, R104W, the river edge slopes gently and is well vegetated. Upland, mature green ash and scattered cottonwood trees with smooth brome understory. Reed canary grass, sandbar willow, Emory's sedge, and quack grass are the predominant vegetation below the OHWM.

In Section 35, T151N, R104, the riverbank the river edge slopes gently and is well vegetated. A narrow wooded strip of mature cottonwood and green ash trees are between the riverbank and the cultivated crop fields on the upland. Smooth brome is common on the upland along the riverbank. Sandbar willow and reed canary grass are the most common species below the OHWM. Charbonneau Creek flows into the Yellowstone near Y15110435R4, just south of the railroad bridge. A dense growth of shrubs and willows are on the depositional areas near the mouth of the creek. Depositional soils around the railroad and bridge structures support sandbar willow.

Yellowstone River - Highway 200 north to Confluence (Area 3)

Left Bank

North of the Highway 200 a narrow river channel flows on the west side of a large island in Sections 26, and 23, T151N, R104W. The riverbank is a gradual sloping bank with vegetated shelves. Dogbane, curled dock, and reed canary grass are the dominant

wetland vegetation with patches of sandbar willow in shallow areas. Water smartweed was commonly observed floating at the waterline. Smooth brome is the dominant upland species. A dense stand of green ash separates the river from cultivated fields. North of this area, hayfields are located up to the river's edge (Section 23). The left bank in the center of Section 23, T151N, R104W is a steep vertical cut. Multiple shelves are present along the water line and numerous clumps of smooth brome sod that has fallen to the shoreline. Fields on the upland above the cut support smooth brome hay.

The 2009 aerial photo shows evidence of an older channel in the Section 14 and north into Section 11. In June 2009, transects were placed along the river edge. In a re-inventory in November of 2009, after a study of 2009 aerial photography, a small channel near an access road was reviewed. On the south end, this channel was separated from the main river channel by a higher area of smooth brome grass. Reed canary grass dominates the channel. Sandbar willow is common from the channel to the riverbank. This narrow channel continues to the north-northwest. Uplands above this river segment are cultivated and likely flood-irrigated. Judging from the 2009 aerial photos, it appears that constructed upland drainage channels are located throughout this area. Due to these various reasons, the OHWM line was kept as originally surveyed in June 2009.

Section 2, T151N, R104W has a barren cut bank. The cut bank includes multiple shelves near the waterline and a nearly vertical cut adjacent to the uplands. The vertical cut is approximately 6-10 feet in height. Scattered patches of smooth brome are along the uppermost shelf (base of the vertical bank). Patches of wetland vegetation including sandbar willow, Emory's sedge, and reed canary grass are along the bank shelves. Numerous slumped clumps of smooth brome sod have fallen from the upland area. Cultivated crop fields are located above the riverbank.

Sections 35 and 26, T152N, R104W include cut banks in the southern portion of Section 35, sloping banks along an old channel in the north portion of Section 35, and grassy banks in Section 26. The cut banks in the southern portion have similar characteristics to those found in Section 2, T151N, R104W. The riverbank follows an old channel that separates a dense wooded area of cottonwood, green ash, and dying peachleaf willow trees from an old sandbar of young cottonwood, Peachleaf willow and sandbar willow. The sloping riverbank in this portion is primarily barren with large amounts of exposed tree roots and wrack. Smooth brome is prevalent just above the OHWM. The riverbank in Section 26 consists of a grassy area located between the river's edge and a dense wooded area of cottonwood trees. A low sand berm covered with reed canary grass and sand bar willow is along the river edge. The bank gradually slopes towards an upland berm covered with mature cottonwood trees and smooth brome. Reed canary grass and patches of sandbar willow are the primary wetland species below the OHWM. The OHWM is located just below the cottonwood and smooth brome area.

Right Bank

North of Highway 200, from Y15110426R3 to Y15110423R3 the right bank of the Yellowstone River is located along the base of high steep cliffs. Multiple shelves are found near the water line. The riverbank is barren with the exception of small depositional areas that are vegetated with sandbar willow and reed canary grass (e.g. between Y15110426R3 and Y15110426R4). Patches of water smartweed were commonly floating at the water line in this portion of the riverbank.

The cliffs continue through Section 23 and the S½ of Section 14, T151, R104W, although a large sandbar dominated by peach leaf and sandbar willow abuts the river cut. Numerous braided channels flow through the sandbar. A dense growth of sandbar and Peachleaf willow grow at the base of the bank just below the OHWM. Quack grass and reed canary grass are common in the dense band of willows. Smooth brome, Canada thistle, and western wheatgrass dominate the upland just above the OHWM (Figure 4). A narrow strip of mature green ash and smooth brome understory are above the river bank and separate the river from cultivated fields farther upland.

Figure 4. Sandbar willow along the right bank of Yellowstone River in Section 23, T151N, R104W. A vertical cut is found along the OHWM. Photo was taken from the upland facing the river. Sandbar willow shrubs are approximately ten feet tall in this area. Understory vegetation is generally lacking.

The right bank of the Yellowstone in Sections 11 and 2, T151N, R104W, varies between steep cut banks and sloping banks on the upland portions of sand bars. The cut banks are nearly vertical 8-10 foot with multiple smaller shelf areas along the water line. The

banks are mostly barren with patches of Emory's sedge and reed canary grass. Slumped clumps of smooth brome sod and other upland species are frequently found along the water line. The riverbank portions located at the upland edge of the sandbars consists of a 3-5 foot high segment along the upland edge and a more gradual sloping portion at the junction of the sandbar. Sandbar willows dominate the sandbars. Patches of reed canary grass and Emory's sedge are prevalent just below the OHWM. Smooth brome and buckbrush are common just above the OHWM. A woodland with an open stand of mature green ash and understory of smooth brome are on the upland.

The right bank of the Yellowstone in Sections 35, 26, and 23, T152N, R104W, is a steep cut bank. The cut bank includes multiple smaller shelves near the waterline and a nearly vertical cut, approximately 6-10 feet in height, adjacent to the uplands. Scattered patches of smooth brome are along the uppermost shelf (base of the vertical bank). Patches of wetland vegetation including sandbar willow, Emory's sedge, and reed canary grass are along the shelves of the bank. Numerous slumped clumps of smooth brome sod are on the shelves. Open woodlands of mature green ash and smooth brome are above the OHWM. The riverbank has inclusions of well vegetated sandbars with reed canary grass, prairie cordgrass, and sandbar willow below the OHWM and smooth brome above the OHWM.

2.0 MISSOURI RIVER

ND/MT border to Houston Engineering's Previously Completed Area (Area 1)

Left Bank

The present-day Missouri River enters North Dakota at the west edge of Section 7, T152N, R104W, flowing southeasterly through Sections 7 and 8. The left bank (north) of the river has a broad willow / reed canary grass flat that varies from 500 feet to 1,000 feet in width before tapering to the shoreline in Section 17. A band of peachleaf willow lies along the OHWM above the willow / canary reedgrass flat through Sections 7 and 8 (Figure 5). Upland species begin on a steep sloped bank ranging from 15 – 20 feet high. Crested wheatgrass is common on the upland. In Section 17 and the NW corner of Section 21 the OHWM continues along the shoreline of the Missouri River. At this point, the OHWM, as determined in this study, converges with a delineation conducted by Houston Engineering in 2007.

Figure 5. Upland and wetland vegetation in Sections 7 and 8 along the left bank of the river. Photo was taken facing east.

Right Bank

On the right bank the Missouri enters North Dakota with a vertical cut approximately ten to twelve feet in height. This active cut bank continues for approximately 100 feet. After the cut bank, a small depositional area against the bank supports a dense stand of sandbar willows between the OHWM and the river channel. Farther downstream, depositional areas are older and larger. In Section 17, several older channels create a wider area between the main river channel and the OHWM (Figure 6). Wetland species dominate the large area, although upland species occur on levees developed adjacent to the numerous channels, creating narrow linear bands of upland species within the wetland flat.

Figure 6. Appearance of channel along the OHWM in Section 17. Upland to the left and river to the right. Note Russian olive on levee on bank of channel. Photo was taken facing mostly north (upstream).

The OHWM has been altered by the construction of the highway bridge in the south portion of Section 17. Fill material around the bridge base is dominated by upland species. It is understood that the OHWM migrates through the highway and continues on the east side of the bridge. The OHWM west of the bridge is adjacent to an elevated road or berm (Figure 7). Cornfields are planted adjacent to the road and the plants nearer the road have shorter stature than the rest of the field due to inundation. The OHWM continues through Section 20 into an area that includes an abandoned oxbow in Section 21. Due to previous court decisions, the team was instructed by the State not to delineate the oxbow, and to continue the survey along the water's edge. Because of this, the delineation team completed the survey at the river or water's edge in Section 21 and into Section 22, where is connects with the OHWM line determined from the Yellowstone River delineation.

Figure 7. Road between the observed OHWM and the upland area. The road likely prevents field runoff from entering the area. Photo taken facing southeast (downstream).

Confluence Area (T152N R104W) (Area 2)

Left Bank

The left bank in Sections 15 and 14, T152N, R104W, is a cut bank. The cut bank includes multiple shelves near the waterline and a nearly vertical cut adjacent to the uplands. The shoreline has riprap on the banks and the boat ramp located near the confluence. The bank is approximately 6-10 feet in height. Scattered patches of smooth brome with inclusions of reed canary and curled dock are along the bank. Near the center of Section 14, the riverbank follows an old channel behind a depositional sandbar covered with a dense stand of peach-leaf and sandbar willows. Smooth brome is prevalent just above the OHWM. A narrow strip of mature green ash and cottonwoods are above the OHWM, separating the riverbank from cultivated crop fields above.

Right Bank

The OHWM on the right bank in Section 15 was not clearly identified along the outside bank of the peninsula that is located east of the mouth of the Yellowstone River due to misdirection from the State. A review of recent aerial, low-oblique air photos, and observed vegetation conditions indicate potentially active channels farther south within the penninsula, warranting additional study. Vegetation on M15210415R1, M15210415R2 and M15210415R4 are over 50% wetland vegetation above the river bank. Vegetation on M15210415R3 has a dominance of upland above the OHWM, but all upland vegetation is smooth brome. Further investigation is necessary to determine if it is a brome area or

just a smaller patch in a wetland area. This additional investigation was completed in the summer of 2010. Upland species increase in Section 14, but on M15210414R1 and R2, 40% wetland vegetation remains above the OHWM.

Figure 8. Vegetation near the OHWM includes large peach leaf willows with watermarks, understory of wetland vegetation, wrack and matted litter and debri.

Downstream of Confluence (Area 3)

Left Bank

On the left bank through Sections 13, 24, and 25, willow and reed canary grasses are dominant between the main river channel and the OHWM. Numerous sand levees are present in this area. Reed canary grass and prairie cordgrass dominate lower areas and smooth brome is common on the raised levees. Slender wheatgrass and quack grass dominate the margins between the reed canary grass and raised levees with smooth brome. The OHWM for the left bank in Sections 30, 29, 20, 21, 16, 15, and 14 will be completed following an additional delineation which was completed in the summer of 2010. Additional info regarding this decision is located below under the Furlong Loop Area portion of the report.

Right Bank

Farther downstream of the confluence, the right bank (Section 23 and downstream to the SE¼ Section 25 and into Section 30 T152N, R103W) is an eroded cut. Multiple, near-vertical shelves are near the waterline. The eroded cut is approximately 5-7 feet in

height. Scattered patches of smooth brome are along the uppermost shelf, with patches of wetland vegetation including sandbar willow, sedges, and reed canary grass sporadically located along the lower shelves. Slumped clumps of smooth brome sod are common on the bank shelves. Quack grass and reed canary are along the lower edges of the bank. A dense growth of young cottonwood is behind the bank. Mature cottonwoods are further back from the river's edge. A large backwater area is included in this area. Water flows from north to south in the main river channel but as the river turns easterly and narrows in Section 30, water is pushed behind an older sandbar area, and flows back north into Sections 25 and then into Section 24. Between the backwater channel and river channel, slightly elevated ridges of cottonwood parallel the main channel. The backwater channel flows across a hay meadow and into a wooded area of box elder and peachleaf willow trees.

Furlong Loop Area (T152N R103W) (Area 4)

In 1958, in order to alleviate flooding issues, the US Army Corps of Engineers (COE) constructed a new channel at the base of the Furlong Loop oxbow in Section 15 T152N R103W. The newly formed channel is now the main channel for the Missouri River through this area, so it had a definite affect on the OHWM. Due to court decisions, the client requested at the time the delineation was being completed, that the OHWM be delineated along this constructed channel. Because wetland vegetation is persistent up through the abandoned oxbow to the north, the OHWM was not placed per continuous wetland vegetation as defined in the guidelines, but along the main channel of the river as directed by the State. The delineation team had asked the State for guidance on how to migrate from one delineation line to the next through this area, and the team was told a decision would be forthcoming. However, the decision was not made until after the team had completed their field work. Due to these factors, this area warrants further study which was completed in the summer of 2010.

Left Bank

On the left bank, uplands north of the Missouri River in Sections 30, 19, 20 and 16, are irrigated farmland. Due to the upland drainage, the irrigation runoff enters the river in this area. Peachleaf willow and dogwood grow below the OHWM. Watermarks on the trees are up to two feet high. Sandbars in the main channel are also very common. As mentioned above, additional study will be needed for this area, which is to be completed in the summer of 2010.

Right Bank

The right bank of the river in Sections 30 and 29, T152N, R103W, is a steep cut bank at the base of high barren breaks. The cut bank includes multiple shelves near the waterline and a near vertical cut adjacent to the uplands. The cut is approximately 6-10 feet in height. Patches of wetland vegetation including sandbar willow, Emory's sedge, and reed canary grass are sporadically located along the shelves of the bank. Smooth

brome sod clumps are slumped onto lower shelves. Patches of mature green ash with a Kentucky bluegrass understory were scattered at the base of the cliffs on top of the bank.

In Sections 28, 21, 22, and the western portion of 15, T152N, R103W, the OHWM also lies near a steep cut bank. The cut bank includes multiple shelves near the waterline and a nearly vertical cut adjacent to the uplands. The vertical cut is approximately 6-10 feet in height. Scattered patches of smooth brome are along the uppermost shelf. Patches of wetland vegetation including sandbar willow, Emory's sedge, and reed canary grass are sporadically located along the shelves of the bank. Numerous slumped clumps of smooth brome are on the shelves. The Scattered patches of mature green ash with a smooth brome understory is present at the top of the riverbank. Cultivated crop fields are on distant uplands.

The OHWM continues along the primary river channel into the center of Section 15, T152N R013W where the river crests a willow sandbar. The older channel runs southeast and continues through the northeast quarter of Section 23 before returning to the main channel in the southeast corner of Section 14. The older channel has a steep bank with reed canary grass and quack grass. Large decadent cottonwoods are in the back area. A woodland area with an open stand of mature green ash and smooth brome understory borders the top of the old channel and separate it from cultivated crop fields.

In Section 13, T152N, R103W, and Sections 7 and 6 of T152N, R102W, the OHWM continues along a steep cut bank. The cut bank includes multiple shelves near the waterline. A near-vertical cut adjacent to the uplands is approximately 6-10 feet in height. Scattered patches of smooth brome are along the upper break. Patches of wetland vegetation including sandbar willow, Emory's sedge, and reed canary grass are sporadically located along the shelves of the bank. Numerous clumps of smooth brome and Kentucky bluegrass have slumped down to lower shelves. Above the OHWM, western wheatgrass is common on the slopes with patches of green ash and Rocky Mountain juniper in the shallow cuts along the cliff face. In the north portion of Section 6, the OHWM is located on the back edge of densely vegetated sand bars. Sand bar willow is the primary vegetation found on the sand bars.

An upland drainage channel near the north edge of Section 6, T152N, R102W drains east to just above the cut bank overflowing south into Section 6 and north into Section 34, T153N, R102W. No inlets were observed except a small inflow at the north end of Section 6. Wetland vegetation, primarily quack grass, in Section 6 above the OHWM is attributed to upland flow. A drainage ditch is located at the north edge of Section 6, draining into the river. Only a very small inlet from the river was found near M15310234L3. Wetland vegetation south of this point was attributed to upland flow.

Trenton Loop Area (T153N R102W) (Area 5)

Vegetation throughout this area is highly influenced by Trenton Loop or Trenton Lake, which is an old oxbow lake and former river channel that back drains to the river, but is hydrologically connected. Uplands in the area are tilled and are irrigated, and areas are diked to prevent floodwater from the river from inundating the cropland. All of this has had a direct impact on the local hydrology and ultimately the OHWM, especially along the left or west bank. It was decided by all parties that this area warranted further study in sections 33, 28, 29, 30, and 19, and this was completed in the summer of 2010.

Left Bank

For the left bank, at the south edge of Section 34, T153N, R102W, an irrigation canal runs perpendicular to the river, cutting off the majority of the water flow between Section 6, T152N, R102W and Section 34. From the south edge of Section 34, north to the center of Section 33, vegetation is highly variable. The only inlet is located near M15310234L3. Several channels in the area are from backflow or are older river channels. Reed canary grass dominates the numerous channels in this area. A constructed diversion lies between the upland and the river, restricting water flow from the river to the uplands. In Section 29, a defined bank is identified near the OHWM. Tilled and irrigated alfalfa fields are on the uplands. Sandbar and peachleaf willows are common below with scattered Russian olive. Due to the features identified, the team felt this area in Section 29 and into Section 30, warranted further study, and this was completed in the summer of 2010.

Continuing on into the north portion of Section 30 and into Section 19, the OHWM follows the edge of a developed road, until turning east along the north bank of Trenton Lake. The majority of the lake edge has a long gentle slope that runs to a cut bank. Wetland vegetation on the slope is variable, from sandbar willow to barren scoured areas. In Section 20 the OHWM turns east along a channel that goes east through Section 20, 21, and part of Section 22. Vegetation below the channel includes a large willow flat. Along the east edge of Section 22 and adjacent west edge of Section 23, constructed manmade irrigation features are present.

In Section 23 the OHWM lies above a willow flat and farther downstream is directly near a cut bank. The OHWM then turns directly east and continues along a channel above a large willow flat, easterly through Sections 26 and 25. It then turns north above the willow flat through Sections 19 and 18. In Section 13, the OHWM meanders back west and then north into Sections 14 and 11, up to the railroad tracks that run next to the riverbank. In Section 11, a small rise is behind the OHWM and then the elevation decreases and wetland vegetation continues to the west. Although the area is relatively level, a small rise separates the river from the upland flow.

In Sections 11 and 12, the OHWM continues along the railway, going around a small hill in Section 12. Between M153102l4, downstream to M1531O206L2, vegetation is variable and there is evidence that vegetation growth is being impacted by ATV's and also by the railway. A willow flat with reed canary grass dominates the area although smooth brome and Canada thistle are common on trails in the area. In Sections 1 and 6, the willow area narrows to a small band along the rivers edge. The OHWM follows a cut bank to the Highway 85 Bridge.

Right Bank

The right bank of the Missouri in this same Trenton Loop area, starting in Section 34, T153N, R102W, is a steep bank that is well vegetated. The delineated OHWM lies along an old channel located behind a sand bar with mature peachleaf willow. Reed canary grass is the dominant wetland vegetation along the riverbank. Smooth brome is dominant on uplands. Level hayfields and cultivated crop fields are on the uplands behind the smooth brome edge. An open woodland of mature green ash trees with a smooth brome and buckbrush understory is along the top of the riverbank in this area. A shallow backwater area is present in the middle of Section 34. Water flows from the south over a low bank and into a shallow channel towards the northeast. Reed canary grass and seedling cottonwoods are present in and along the channel. Older cottonwoods and smooth brome outline the backwater area. Water flows back to the river after the river water levels subside.

Continuing downstream, river water is pushed over a small inlet in the NW¼NW¼ Section 34. Water crosses a low barren cut bank topped with sand bar willow. The water flow is perpendicular from the main river channel towards the southeast through a dense stand of cottonwood, green ash trees, reed canary grass and prairie cordgrass located in Sections 35 and 36. The channel deepens and widens as it flows downstream (southeast) until it encounters a large backwater lake. The banks along the channel are 3-5 feet in height and are well vegetated. Exposed tree roots are present along the bank. The banks become steeper and deeper downstream. Large patches of mature peachleaf willow trees are in the bottom of the backwater area. Hayfields and cultivated crop fields are present on top of the riverbank. Dense cattails and sand bar willows are prevalent in Section 36.

In Section 25, T153N, R102W, and the west portion of Section 30, T153N, R101W, the right bank is a steep hillside. Mature green ash trees are on the hillside. The OHWM is located along the base of the steep hillside above a flat of peachleaf willow, sand bar willow and reed canary grass. Smooth brome is found just above the OHWM in open areas. Water crests a low bank of peachleaf and sand bar willow, pushing against the hillside and creating extensive amounts of wrack throughout the area. An irrigated field is located on top of the steep hill.

West of the Highway 85 Bridge (T153N R101W) (Area 6)

The right bank in the east portion of Section 30 and Sections 20 and 17, T153N, R101W, is a cut bank with multiple shelves. The shelves are barren from water flow while the slopes above them are well vegetated with reed canary. An improved gravel road is present along the top of the bank. Riprap is on the riverbank in Section 20. The OHWM is located above the riprap at the upper edge of the wetland vegetation community. Multiple oil well sites are located across the gravel road.

In Section 18, the OHWM is on a steep cut bank. The cut bank includes multiple shelves near the waterline and a vertical cut adjacent to the upland. Smooth brome is along the uppermost shelf near the vertical bank. Wetland vegetation includes sandbar willow, Emory's sedge, and reed canary grass. A low sandbar with sand bar willow is located just downstream of the cut banks. The river crests the sand bar flowing north through a small channel that cuts through a mature cottonwood stand. The channel is 3-4 feet wide and approximately 2 feet deep, becoming deeper and wider as it flows north into Section 7. Reed canary grass is dominant in the channel, eventually becoming a wide area of sandbar willow, cattails, and standing water. The channel continues through Section 7, flowing back into the main river channel near the center of Section 6. The right bank in the eastern portion of Section 6, is a steep cut bank that includes multiple shelves. A vertical cut, approximately 6-10 feet in height, is adjacent to the upland. The field delineation ceased for the right bank in Section 6 on the west side of the bridge.

As mentioned above, for the OHWM on the left bank in sections 1 and 6, there exists a willow area that continues from sections 11 and 12 that narrows to a small band along the rivers edge. The OHWM then follows a cut bank to the Highway 85 Bridge.

East of the Highway 85 Bridge (T153N R101W & T154N R101W) (Area 7)

Due to the varying conditions and indicators identified on the south side or right bank area located east of the Highway 85 Bridge, it was decided by the team and the State that this delineation would only be completed for the north side, or left bank. The right bank or south side in this area likely warrants future delineations or further study.

The left bank, east of the Highway 85 Bridge is a constructed levee located above the river that begins near the bridge. The side of the levee adjacent to the river is rip-rapped. The wetland area identified below the OHWM is very wide and expansive before reaching the main river channel. Smooth brome is commonly growing through the rocks. Wetland vegetation is primarily reed canary grass and willows. Very few cottonwoods are in the area. Canada thistle is common and is in very dense stands. The field delineation was carried through Section 27 on the north side or left bank.

NOTES:

VI. PROJECT DATA

A. Final Acreage Determinations (Included with the Report)

B. Data Discs (Located in back cover of Report – 4 Total)

1. Delineation Data Forms (PDF)
2. Delineation Point Photos (PDF)
3. Final Maps (PDF)
4. OHWM Report (PDF)
5. GIS Data
    i. Delineation Points
    ii. OHWM Line
    iii. Acreage Polygons
6. Aerial Video
7. Final Acreage Determinations

C. Final Maps (Separate from Report – One bound set)

D. Delineation Data Forms were Provided to the ND State Water Commission