2012 Annual Wetland Monitoring Report

for the

Platte West Water Production Facilities Project

METROPOLITAN UTILITIES DISTRICT

Project No. 60787

January 2013

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for the

Platte West Water Production Facilities Project

prepared for

Metropolitan Utilities District
Omaha, Nebraska

January 2013

Project No. 60787

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

EXECUTIVE SUMMARY

The Metropolitan Utilities District (District), Omaha, Nebraska, was issued a Section 404 Individual Permit (Permit) on May 16, 2003, from the U.S. Army Corps of Engineers, Omaha District (Corps), for the Platte West Water Production Facilities Project (Project) (U.S. Army Corps of Engineers 2003). As part of the terms and conditions included in the Corps Section 404 Permit, the wetlands located in the well fields and projected cones of depression must be monitored to determine the extent of any impacts to wetlands that may take place as a result of Project operation. To comply with this condition, a Wetland Monitoring Plan was prepared and approved in 2005 and is now being implemented (Burns & McDonnell 2005a).

As part of the Wetland Monitoring Plan, vegetation monitoring of the wetlands in the well fields was conducted in September 2012 to characterize major wetland and upland plant communities and the variation between them. This sampling effort represents the fourth year of monitoring during operation of the water treatment plant. Vegetation sampling took place in sample plots along permanent transects and gradsects established in each wetland ecosystem. Data obtained during 2012 has been analyzed and compared to baseline data and the results are discussed in this annual report and included in Appendix I.

For the first time since Project operation began in August 2008, two of the three wetlands monitored in 2012 (W-25 and W-100) showed calculated mean weighted average (WA_M) values above the recorded baseline maximum values. Additionally, all three of the monitored wetlands showed statistically significant differences in three or more of the other vegetative indices used to further assess the data. As explained in the report, 2012 pumping in the well fields occurred at a slightly lower rate than in 2011. As documented by the monthly historical Palmer Z Drought Indices for 2012, as provided by the National Climatic Data Center of the National Oceanic and Atmospheric Administration (NOAA), the region was experiencing extreme drought conditions at the time of the 2012 monitoring. These conditions coupled with monitoring occurring only in the fall likely had a significant impact on the observed vegetation indices.

As a result of the conditions observed in the monitored wetlands and in particular due to the extreme drought conditions experienced in the region in 2012, it is recommended that wetland monitoring efforts in 2013 continue without changes to the methodology at this time. Level 2 decreased monitoring is conducted once annually and will rotate between the June and September sampling seasons. Since 2012 vegetation monitoring took place in September,

wetland monitoring will be conducted in June 2013 at the emergent wetlands only. Data gathered during the June 2013 monitoring effort will be quickly processed, analyzed, and compared with other local climatic and hydrologic conditions to try to ascertain if the emergent wetlands are recovering from the drought conditions. Additional monitoring may be necessary in the fall of 2013 based on the June analysis.

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1.0 INTRODUCTION

The Metropolitan Utilities District (District), Omaha, Nebraska, was issued a Section 404 Individual Permit (Permit) on May 16, 2003, from the U.S. Army Corps of Engineers, Omaha District (Corps), for the Platte West Water Production Facilities Project (Project) (U.S. Army Corps of Engineers 2003). As part of the terms and conditions included in the Corps Section 404 Permit, the wetlands located in the well fields and projected cones of depression must be monitored to determine the extent of any impacts to wetlands that may take place as a result of Project operation. To comply with this condition, a Wetland Monitoring Plan was prepared and approved in 2005 and is now being implemented (Burns & McDonnell 2005a).

As stated in Permit Condition 37: "The purpose of the monitoring is to identify any changes in the existing or future wetlands or aquatic sites impacted as a result of project development and operation." Both temporary and permanent impacts to wetlands are expected to result from the construction and operation of the Project, which is located in Douglas and Saunders Counties, Nebraska. The 2005 Wetland Monitoring Plan presents a systematic, multi-tiered approach to monitor wetlands within the Douglas County and Saunders County well fields and their associated cones of depression to evaluate any impact due to the operation of the Project.

Wetlands selected for monitoring were chosen from those identified during the delineations conducted in the well fields (Burns & McDonnell 2004) and in the cones of depression (Burns & McDonnell 2005b). Monitoring of wetlands in accordance with the Wetland Monitoring Plan was initiated in June 2005. Annual monitoring reports, characterizing each year's monitoring effort (2005 through 2007) and culminating in the *Baseline Wetland Monitoring Report*, were submitted for each year of baseline monitoring (Burns & McDonnell 2006a, 2007a, 2008, 2009). Monitoring through spring of 2008 was conducted to characterize the baseline conditions of the wetlands prior to initiation of Project operation. The Project began producing water for municipal use during the summer of 2008; therefore, the monitoring efforts from fall 2008 through the present are considered operational.

This report summarizes the 2012 monitoring effort and provides some comparisons to the baseline and operational conditions.

* * * * *

2.0 SAMPLING METHODOLOGY

The goal of monitoring wetlands within the Douglas County and Saunders County well fields and associated cones of depression is to evaluate the impact that operation of the Project may have on the existing wetlands. To accomplish this goal, a wetland monitoring approach consisting of a systematic, multi-tiered vegetation sampling procedure has been developed, approved, and implemented. In developing this vegetation sampling procedure, numerous literature sources and references were reviewed. Several discussions with personnel from the Corps and the District occurred during the preparation of this plan and the synthesis of the approach. Key references and sources used included:

- 1987 Corps and 1989 Federal wetland delineation manuals (Environmental Laboratory 1987 and Federal Interagency Committee for Wetland Delineation 1989)
- performance standards for wetland creation and restoration (Streever 1999 and Environmental Law Institute 2004)
- vegetation sampling and analysis methodologies (U.S. Environmental Protection Agency 2002 and Tiner 1999)
- wetland mitigation guidelines (Taylor and Krueger 1997)

Wetland monitoring, as stated above and described in the following paragraphs, began during Project construction in 2005, prior to initiation of Project operation. Monitoring will continue until the Corps agrees that any impacts to wetlands as a result of Project operation are either completely mitigated for or are not likely to occur. If the results of the monitoring program indicate that no wetland impacts are occurring, long-term monitoring can either be decreased or stopped, in accordance with the thresholds analysis discussed in Section 4.0 Thresholds. If the results of the monitoring indicate effects are occurring to wetlands that have not been previously mitigated, discussions with the Corps will be initiated to determine what additional mitigation may be required.

2.1 WETLAND MONITORING IN THE WELL FIELDS

The types of data that were collected, the methods used, and the analyses completed during the wetland monitoring process in the well fields are described in the paragraphs that follow.

2.1.1 Vegetation Sampling

Vegetation was sampled in selected wetlands in the two well fields to characterize the major wetland and adjacent upland plant communities and the variation between them. Wetlands where vegetative change was most likely to be detected first were selected for vegetation sampling; these wetlands are referred to

as "primary" wetlands. In past years, vegetation sampling in these primary wetlands occurred twice each year, in mid-June and in late September. In 2011, the monitoring intensity decreased from Level 1 (monitoring of PEM wetlands twice yearly) to Level 2 (monitoring of PEM wetlands once yearly) based on the data collected during monitoring to date. Level 2 Decreased Monitoring continued in 2012 with the yearly monitoring effort taking place in September. The discussion of threshold levels in Section 4.0 details the criteria for a switch between monitoring levels and the procedures followed at each level.

If Project operation-induced impacts to wetland vegetation are observed and documented in any of the primary wetlands, the monitoring of nearby secondary wetlands will be initiated. The monitoring of the secondary wetlands, in addition to the primary wetlands, will help determine if the observed impact is localized and confined to the primary wetland, or is spreading to the adjacent or surrounding wetlands. The primary and secondary wetlands that are being or will be monitored in the Douglas County and Saunders County well fields are shown in Figures 2-1 and 2-2. The wetlands in the Saunders County well field are monitored more extensively than wetlands in the Douglas County well field due to the presence of the 95-acre Wet Meadow in Saunders County. However, the proposed monitoring plan is flexible and can be adjusted to meet specific identified needs for monitoring if they develop.

Vegetation sampling methods used vary depending on the type of wetland vegetation being sampled. These differences in methodologies are described in the following sections.

2.1.1.1 Palustrine Emergent Wetlands

The vegetation in a palustrine emergent (PEM) wetland is normally comprised of herbaceous plant species. However, seedlings of woody plants less than one meter tall may also be included in the PEM wetland vegetation. Herbaceous plant species were sampled using gradient-oriented transects, or "gradsects". A gradsect is defined as a transect that is placed perpendicular to the baseline transect along the ecotone gradient. The ecotone is the distinct area where one plant community changes or intergrades into another separate, distinct plant community. Sampling units are located in the center of each vegetation community and at each ecotone. The sampling unit consists of five, three-foot-diameter circular sample plots placed along the gradsect. Three baseline transects with between two and seven gradsects have been placed in each PEM wetland.

Vegetation and wetland monitoring in the PEM wetlands began in 2005. During the first sampling period in June 2005, each permanent transect, gradsect, and sample plot was located and recorded using a global positioning system (GPS; Trimble® Pro XRS sub-meter GPS unit). The beginning and end of each

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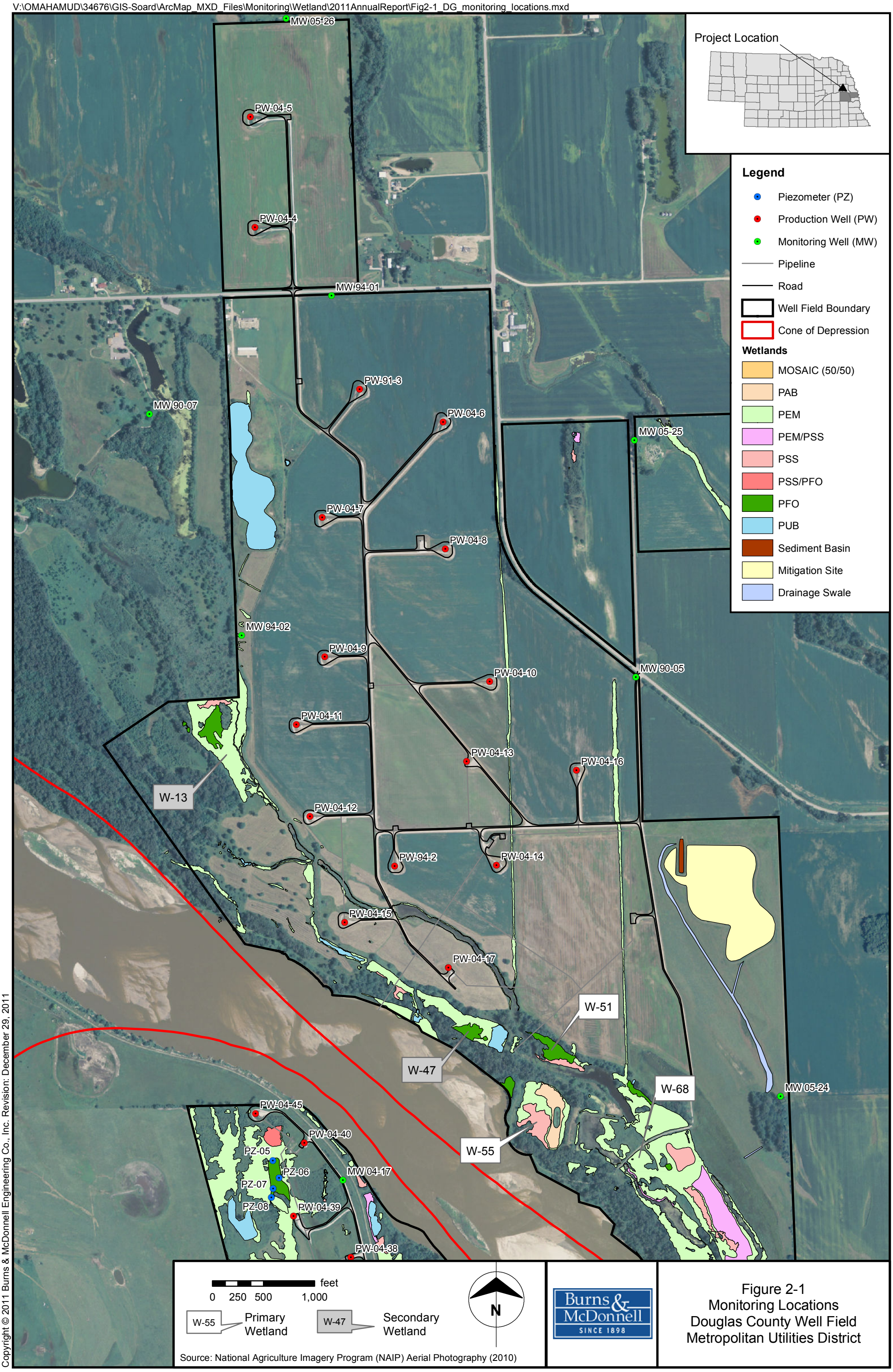

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PW-04-45
PW-04-40
PZ-05
PZ-07
PZ-06
PZ-08
PW-04-39
MW 04-17
W-5
PW-04-38
W-50
PW-94-37
W-17
MW 90-10
PW-04-49
PZ-01
PW-94-36
W-25
PZ-02
PZ-03
PW-04-44
PZ-04
W-54
PZ-13
PW-94-35
W-31
PZ-14
PZ-15
PW-04-43
PW-94-34
PZ-17
PZ-16
PZ-18
PW-04-42
PW-94-33
PW-94-32
PW-04-46
PW-04-41
PW-94-31
MW 94-04
PW-04-54
PW-04-55
PW-91-30
PW-04-52
PW-04-53
PW-04-50
PW-04-51
PW-04-48
PW-04-47
PZ-12
W-100
PZ-11
MW 05-23
MW 05-22
PZ-10
PZ-09

Project Location

Legend

- Piezometer (PZ)
- Production Well (PW)
- Monitoring Well (MW)
- Pipeline
- Road
- Cone of Depression
- Well Field Boundary

Wetlands

- MOSAIC (50/50)
- PAB
- PEM
- PEM/PSS
- PSS
- PSS/PFO
- PFO
- PUB
- Mitigation Site

feet
0 250 500 1,000

W-55 Primary Wetland
W-47 Secondary Wetland

N

Source: National Agriculture Imagery Program (NAIP)
Aerial Photography (2010)

Burns & McDonnell SINCE 1898

Figure 2-2
Monitoring Locations
Saunders County Well Field
Metropolitan Utilities District

transect and gradsect were permanently marked in each wetland using two-foot sections of 3/8-inch or 1/2 inch re-bar, painted orange and flagged. These permanent markers also serve as photograph stations. A photographic record is being maintained for each sampling period at each gradsect and transect. This photographic record will provide a repetitive visual record of the wetland vegetation monitoring during seasons and over years.

Vegetation and plant species data that were collected during the PEM wetland vegetation monitoring effort include the identification, to species when possible, of each plant located within the three-foot diameter sample plot. The percent cover for each plant species occurring in a sample plot was estimated using a modified Daubenmire cover-class method. In this methodology, percent canopy cover is visually estimated for each plant species either rooted within or extending into each three-foot diameter plot. The plant species is placed into one of a series of cover classes using the estimated percent canopy cover. These classes are based on the mid-point of canopy coverage per the modified Daubenmire canopy cover method shown in Table 2-1 (Daubenmire 1959; Bailey and Poulton 1968).

Table 2-1: Modified Daubenmire Cover Class Scale

Cover Class	1	2	3	4	5	6	7
Range (%)	0-1	1-5	5-25	25-50	50-75	75-95	95-100
Midpoint (%)	0.5	3.0	15.0	37.5	62.5	85.0	97.5

A cover class was also estimated for the non-vegetated area in the three-foot diameter plot because sample plots are often not completely vegetated. Non-vegetated areas can include bare soil, rocky surface, open water, or litter. Quantifying the bare area provides an indication of the potential for additional vegetation in the sample plot. Even with bare area in a plot, the total cover of vegetation may be greater than 100 percent, because plants often overlap in a plot.

If standing water is present within the sample plot, the water depth (in inches) at the center of each plot will be recorded. The percentage of the plot that is inundated will also be estimated and assigned a cover class value that is recorded on the data entry forms.

2.1.2 False-color Infrared (CIR) Aerial Photography

False-color infrared (CIR) aerial photography was initially taken in 2005 and was obtained annually through 2009. In accordance with the reduced monitoring intensity level, as described in Section 4.0 Thresholds, CIR aerial photography will be obtained every-other year. As new CIR photography was obtained in 2011, it will not be flown again until 2013. The CIR photographic coverage typically

includes both well fields and the associated cones of depression in Douglas and Saunders Counties. The annual CIR aerial photography is used to monitor the overall size, shape and condition of the wetlands and different types of vegetation occurring in the well fields over time.

2.2 WETLAND MONITORING IN THE CONES OF DEPRESSION

The Douglas County and Saunders County well fields are owned in fee title by the District. As a result, access to the well fields for vegetation and groundwater monitoring is available at all times. The land surrounding or adjacent to the well fields is projected to potentially experience some groundwater drawdown during Project operation. Groundwater modeling is conducted annually to incorporate data collected from the monitoring and production wells (HDR 2011). The groundwater model is able to predict the area of land surrounding the well fields that is expected to experience a one-foot drawdown of local groundwater during project operation. These areas are designated as "cones of depression" and are larger than the well fields. The originally modeled cones of depression are included in Figures 2-3 and 2-4.

The land outside the well fields but within the cones of depression is not owned by the District. As such, seasonal and annual access to that portion of the cones of depression for consistent wetland monitoring cannot be assured. Therefore, the monitoring methodology for the wetlands within the cones of depression, but outside of the District-owned well fields is based on the interpretation and comparison of the CIR aerial photography. The CIR aerial photography for the cones of depression will be obtained per the methods described in Section 2.1.2 above for the wetland monitoring in the well fields.

A total of eight wetlands in the cones of depression have been selected for secondary monitoring from those that were delineated (Burns & McDonnell 2005b; Figures 2-3 and 2-4). Six of these eight wetlands are emergent wetlands (W-9, W-514, and W-519 in Douglas County and W-306, W-321, and W-700 in Saunders County), one is a PFO/PEM wetland complex (W-5 in Douglas County), and one is a PFO wetland (W-8 in Douglas County). More emergent wetlands are being monitored than other types of wetlands due to the fact that more emergent wetlands were delineated in the cones of depression than any other type of wetland.

2.3 HYDROLOGICAL MONITORING

Several different types of hydrological data are being collected and analyzed. This hydrological data is being used to document the effect the existing water table has on wetlands in the two well fields and the potential effect Project operation may have.

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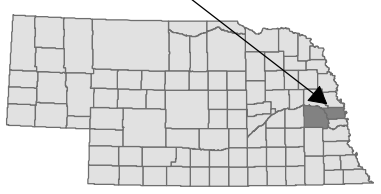
Project Location



MW 90-04

Legend

- Piezometer
- Production Well (PW)
- Monitoring Well (MW)
- Pipeline
- Road
- Cone of Depression
- Well Field Boundary

Wetlands

- MOSAIC (50/50)
- PAB
- PEM
- PEM/PSS
- PSS
- PSS/PFO
- PFO
- PUB
- Sediment Basin
- Mitigation Site
- Drainage Swale

W-519
MW 05-26
PW-04-5
W-514
PW-04-4
MW 94-01
PW-91-3
MW 90-07
PW-04-6
MW 05-25
W-8
PW-04-7
PW-04-8
MW 94-02
PW-04-9
PW-04-10
MW 90-05
PW-04-11
PW-04-13
PW-04-16
PW-04-12
PW-94-2
PW-04-14
PW-04-15
PW-04-17
PW-04-45
PW-04-40
MW 04-17
PW-04-39
PW-04-38
PW-94-37
MW 90-10
PW-04-49
PW-94-36
PW-04-44
PW-94-35
W-9
MW 90-06
MW 90-12
W-5
MW 05-24
MW06-29

feet
0 1,000 2,000 4,000

W-55 Monitored Wetland

N

Source: Wilson & Co. 2008 Aerial Photography and 2010 NAIP Aerial Photography

Burns & McDonnell SINCE 1898

Figure 2-3
Monitoring Locations
Douglas County Cone of Depression
Metropolitan Utilities District

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PW-04-15
PW-04-17
PW-04-45
PW-04-40
MW 04-17
MW 05-24
PW-04-39
PW-04-38
PW-94-37
MW 90-10
MW 94-05
PW-04-49
PW-94-36
PW-04-44
PW-94-35
PW-04-43
PW-94-34
PW-04-42
PW-94-33
PW-94-32
PW-04-46
PW-04-41
PW-94-31
MW06-28
MW 94-04
PW-04-54
PW-91-30
PW-04-55
W-306
PW-04-52
PW-04-53
W-700
PW-04-51
MW 06-27
PW-04-50
PW-04-48
PW-04-47
MW 05-23
MW 05-22
MW 06-18
MW 94-06
MW-39A
MW 94-03
W-321
MW 94-07

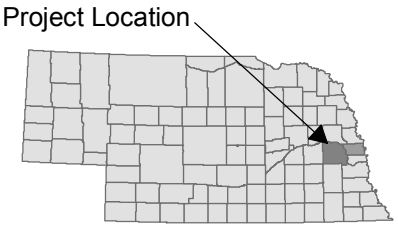
Legend

- Monitoring_Well_06-27
- Piezometer
- Production Well (PW)
- Monitoring Well (MW)
- Pipeline
- Road
- Well Field Boundary

Wetlands

- MOSAIC (50/50)
- PAB
- PEM
- PEM/PSS
- PSS
- PSS/PFO
- PFO
- PUB
- Mitigation Site
- Drainage Swale

Project Location



feet
0 1,000 2,000 4,000

W-55 Monitored Wetland

Source: Wilson & Co. 2008 Aerial Photography and 2010 NAIP Aerial Photography

N

Burns & McDonnell SINCE 1898

Figure 2-4
Monitoring Locations
Saunders County Cone of Depression
Metropolitan Utilities District

2.3.1 Groundwater Monitoring Wells

Permanent monitoring wells designed to measure local groundwater levels have been installed by the District at specific locations in and around the Douglas County and Saunders County well fields and cones of depression (Figures 2-1 through 2-4). The location of these groundwater monitoring wells was recorded using GPS. Data loggers have been installed at the monitoring wells so that groundwater levels can be measured and recorded on a daily basis. Groundwater data from the monitoring wells will be correlated with the other hydrological data that is being collected to evaluate if any Project-induced groundwater system changes are occurring.

2.3.2 Production Wells

The Project production wells that are pumped to provide raw water to the new water treatment facility during Project operation are located in the Douglas County and Saunders County well fields (Figures 2-1 and 2-2). These water production wells have also been fitted with data loggers that measure and record the depth to the water table at each well head whether or not the well is actively being pumped. In addition, the rate at which each well is being pumped is measured in millions of gallons per day (MGD). The locations of these water production wells were recorded using GPS. Data from the water production wells (production rate, drawdown, cone of depression, etc.) during Project operation will be correlated with the other hydrological data that is being collected to evaluate if Project-induced changes to wetlands are occurring.

2.3.3 Piezometers

A total of 18 piezometers were installed in five wetlands in the Saunders County well field (Figure 2-2). Twelve of these were installed in three existing wetlands (four piezometers per wetland) already being monitored as part of the Wetland Monitoring Plan (Burns & McDonnell 2005a). Four piezometers were installed in the Phase I Mitigation Site located adjacent to the Wet Meadow and described in the Phase I Wetland Mitigation Plan (Burns & McDonnell 2005d). The remaining two piezometers were installed in the Phase II Wet Meadow Mitigation Site (Burns & McDonnell 2007c). In July 2010, eight of the existing piezometers were replaced by installing a new piezometer adjacent to the old ones. The replacement of some piezometers was necessary as a result of the undermining of existing piezometers due to frost heave, erosion, or animal activity. A modified installation approach was implemented during the replacement of the eight piezometers. Additional rebar was driven into the ground at divergent angles before the concrete base was poured. This additional rebar should help stabilize the piezometers against frost heave. The locations and elevations of the installed piezometers have been recorded using GPS.

In each of the five wetlands being monitored with piezometers, one of the piezometers was located near the center or low point. Since subsurface groundwater flow is generally from north to south, one piezometer was installed at the northern edge of each wetland; the remaining two piezometers were installed along the southern edge of each wetland.

The piezometers installed in two existing wetlands in the Wet Meadow (W-5 and W-25) and the created Phase I and Phase II Wet Meadow Mitigation Sites adjacent to the Wet Meadow are designed to monitor the shallow, perched water table between the soil surface and the clay layer before and after Project operation begins. Piezometers were also installed in a PEM wetland (W-100) in the southern portion of the Saunders County well field that is outside of the Wet Meadow boundary (and also outside of the perched water table located above the shallow clay layer) to monitor the shallow groundwater prior to and during Project operation. All piezometers are being monitored on an approximately monthly basis during the growing season to assess the seasonal and annual fluctuation in the shallow water table, and the variation between years. For additional information on the installation and monitoring of the piezometers, please refer to Burns & McDonnell's Wetland Monitoring Plan (2005a).

2.3.4 Bathymetric Monitoring of Ponds

Bathymetric monitoring of ponds located in the Douglas County and Saunders County well fields and associated cones of depression was initiated in 2004 (Burns & McDonnell 2005c). Using GPS and a boat-mounted sonar recorder, bathymetric maps were developed for each of the 45 ponds being monitored. These maps established baseline conditions by depicting each pond's water surface area and water depth contours. Prior to initiation of Project operations, water surface elevations at each pond were monitored four times (March, August, September, and October) each year. The pond surface water elevation data collected provides a basis for comparing the seasonal pre-Project changes with the changes that may occur with operation of the Project.

Permanent benchmarks and elevations were established near each pond above the high water mark during the early summer of 2005. The location and elevation of each permanent benchmark was established using a survey-grade GPS. Water surface elevations were measured from the established permanent benchmark using a surveyor's level. The 2005 bathymetric monitoring also included the contour mapping of one pond that was overlooked during the 2004 mapping effort (Burns & McDonnell 2006b). During the 2006 bathymetric monitoring effort, an additional pond was surveyed at the request of the landowner (Burns & McDonnell 2007b). In 2008, two ponds were added and two ponds were removed. An additional pond, DG-11, was added by request of the landowner in 2009 and is being monitored by

photographic documentation only at this time. In 2010, pond DG-02A was added to the monitored ponds at the request of the landowner. Currently, a total of 47 ponds are being monitored.

The seasonal variation in surface water elevation of the 47 ponds will be compared between baseline and operational conditions and evaluated in concert with the other hydrologic data that are being collected. The bathymetric data collected from the ponds will be used to indicate if Project operation is resulting in water level fluctuations for a specific pond or ponds and if these fluctuations are different than would normally occur under baseline conditions.

2.3.5 Other Hydrological Data

Additional hydrological data is also collected during the annual monitoring effort each year. This additional data includes monthly total precipitation, monthly average ambient air temperature, and stream gauge data for the Platte and Elkhorn Rivers.

* * * * *

3.0 DATA ANALYSIS

The following sections provide a brief discussion of the data analysis and the results of the 2012 annual wetland monitoring efforts in the well fields and cones of depression.

3.1 WETLAND MONITORING IN THE WELL FIELDS

The fall 2012 monitoring effort in the well fields consisted of the systematic sampling and analysis of wetland and nearby upland vegetation and the collection and comparison of various types of hydrological data.

3.1.1 Vegetation Data

Vegetation monitoring of the wetlands in the well fields was conducted in September 2012 to characterize major wetland and upland plant communities and the variation between them. This sampling effort represents the fourth full year of monitoring during operation of the water treatment plant. Vegetation sampling took place in sample plots established along permanent transects and gradsects established in each wetland ecosystem as described previously. Data obtained during 2012 has been analyzed and compared to baseline data and the results are discussed below and included in Appendix I. Additionally, some comparisons of vegetation data collected during each sampling period during Project operation have also been included.

All of the wetland vegetation data obtained during monitoring was input into a Microsoft Access database that has been designed specifically to accommodate seasons and years of data. The database was also designed for the rapid comparative assessment of selected vegetative characteristics within and among wetlands and wetland types in general. In 2012, the Corps issued an update to the National Wetland Plant List (NWPL; Lichvar and Kartesz 2009) which resulted in changes to some of the wetland indicator statuses and nomenclature. For consistency and because this is at least the third full year of monitoring at the mitigation sites, nomenclature and plant characteristics were again obtained from the USDA PLANTS Database (USDA NRCS 2012). A complete list of plant species that have been identified in each of the monitored wetlands has been compiled and is included in Appendix IV. The vegetative characteristics that were analyzed are described below.

In the initial data collection process in the field, the percent cover for each plant species observed in each sample plot was estimated. As explained in the following paragraphs, these collected vegetative data were used to calculate a weighted average for each sampling unit in addition to calculating the species richness; species diversity; percent native species; percent invasive species; the percentage of perennial,

biennial, and annual species; the mean coefficient of conservatism (c-value); and the Floristic Quality Index (FQI).

3.1.1.1 Change in Wetness

Species abundance and the wetland indicator status for each species can be used to calculate a measure of how wet an area is. This measure of wetness is referred to as the weighted average (Tiner 1999) or the Prevalence Index (Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0, 2010). For the current year's data, the average or mean weighted average (WA_M) was calculated for each wetland as a whole and for each gradsect located in the emergent wetlands. The WA_M is calculated using the following formula:

$$\text{Mean Weighted Average}\,(WA_M) = \frac{\sum I\,E}{\sum I}$$

where $I = \text{importance value for the species (e.g., percent cover)}$

$E = \text{ecological index for the species}$

The importance value used for this evaluation is the percent cover for the species in the sample plot. The ecological index is a value between 1 and 5 that corresponds to the wetland indicator status for the given species. An ecological index value of 1 corresponds to an obligate or wetland plant and a value of 5 corresponds to an upland plant. The calculated WA_M should be equal to or less than 3.0 in order for a specific site to be considered a wetland if hydric soils and sufficient hydrology are present. In transitional areas, a WA_M should approach 3.5, depending on landscape position, hydrology, and other related features.

3.1.1.2 Change in Species Composition

Change in species composition over time will be analyzed by comparing the various vegetative indices that are being calculated each year. These indices were calculated from the collected data to assist in interpreting any changes observed in the vegetation communities. These additional calculations are explained in the following paragraphs and include:

- Species richness
- Species diversity
- Percent of native vegetation
- Percent of invasive species
- Percent of perennial/annual/biennial vegetation

- Floristic Quality Index (FQI)
- Mean c-value

Species richness is the count of the number of different species identified in a plant community. This parameter is used to help characterize the plant community being examined, and is often used in concert with species diversity indices (Greig-Smith 1983). In most cases, a higher species richness value is obtained from a better quality or more diverse plant community.

Species diversity is an index that combines species richness and equitability (the evenness of the contribution of different species to the community) in order to investigate the heterogeneity of a plant community that is more a measure of the functional or apparent number of species rather than the absolute number of species as in species richness (Greig-Smith 1983). Species diversity in this study is the number of different species in an area weighted by some measure of abundance. Here, the measure of abundance used is the number of occurrences of each species in each wetland out of the total number of plots. The formula for species diversity follows Simpson (1949) and is included below:

$$\text{Species Diversity}\,(D) = \frac{N(N-1)}{\sum n(n-1)}$$

where $N = \text{total number of occurences for all species in all plots}$

$n = \text{number of occurences for each individual species}$

Simpson's Reciprocal Index (1/D) is calculated and included in the data analysis. In general, diversity increases with increasing heterogeneity; so, the higher the diversity value, the more diverse the plant community.

Assessing the abundance of native and invasive species provides an indication of the quality of the plant community and, when used long-term, provides an indication of whether there is a shift in quality over time. For this study, the percent of native vegetation is the percent of plant species out of the total species occurring in the wetland that are considered to be native to the United States. The percent of invasive vegetation is the percent of plant species out of the total species occurring in the wetland that are considered to be invasive in the United States or have the potential to dominate a community to the exclusion of more desirable species. Invasive species can be both native and non-native plants.

Additionally, the percentages of the total plant species that are annual, biennial, and perennial are indicated. This parameter shows the contribution of the different types of plants, and provides, in part, an indication of the diversity of the plant community in question.

A Floristic Quality Analysis (FQA) will also be conducted on the vegetation data. The FQA is typically conducted on vegetation data collected during a pedestrian survey of the whole site. However, because the sampling of these wetlands is so extensive, the FQA calculations will be based on data collected from the sample plots rather than a separate survey. The mean c-value and FQI are calculated using c-values that were assigned for the Nebraska region by Rolfsmeier and Steinauer (2003). The c-value is a number between 0 and 10 that is assigned to each plant species in a region. The c-value assigned is an indication of whether the plant is native to the area and how tolerant to disturbances the species is. For example, a native plant that is found only in intact natural communities would be assigned a value of 10, while an invasive or non-native species commonly found on roadsides, for example, would be assigned a value of 0. The mean c-value is the average of the c-values from the plant species identified in the site.

While the mean c-value provides a measure of the botanical quality of a site that can be compared from year to year, it does not take into account the size of the site or the quality of the surrounding area. Therefore, the FQI is calculated to combine the mean c-value with the total number of species identified in the site. The FQI is calculated using the following formula:

$$\text{Floristic Quality Index (FQI)} = \bar{c}\sqrt{n}$$

where $\bar{c}$ = mean coefficient of conservatism

n = number of native species

With this calculation, higher FQI numbers correspond to more natural sites that have a higher diversity. Lower FQI values imply a more disturbed or lower quality site.

3.1.1.3 Statistical Analysis

Statistical Analysis of the vegetation data was first included in the 2010 Annual Wetland Monitoring Report, since a sufficient number of sampling efforts had taken place since the beginning of operation to allow for an evaluation of the vegetative characteristics. To determine whether any observed changes in the vegetative indices that are calculated each year are significant, a statistical analysis is conducted to compare the baseline data, which captured some of the natural variation in the wetlands, to the operational data to determine if Project operation is having any significant effect on the wetlands. Statistical Analysis is again included in the 2012 Annual Wetland Monitoring Report.

Through discussions between the District, Corps, and Burns & McDonnell, the Repeated Measures ANOVA was selected as the statistical test appropriate for this analysis. The statistical add-on package to Microsoft Excel that was utilized for this analysis is the EZAnalyze program (www.ezanalyze.com). The Repeated Measures ANOVA is able to compare multiple sampling seasons of data against the baseline average for a given vegetative index. A post-hoc analysis is also included when a significant difference is detected to determine which sampling efforts were significantly different. A Bonferroni correction is then applied to the p-values to decrease the error that may occur when comparing multiple data sets. The final p-Bonferroni values are reviewed to determine if any of the sampling efforts are significantly different from the baseline average value. This indication of significance is the analysis used when triggering thresholds for monitoring intensity or identifying possible impacts to the wetland due to Project operation.

The Repeated Measures ANOVA test is conducted on each of the vegetative indices that are calculated for each sampling effort: WA_M, FQI, c-Value, Species Richness, and Species Diversity.

3.1.2 False-color Infrared (CIR) Aerial Photography

In accordance with the reduced monitoring intensity level, as described in Section 4.0, Thresholds, CIR aerial photography was not obtained in 2012, but will be scheduled again in 2013.

3.2 WETLAND MONITORING IN THE CONES OF DEPRESSION

As stated above, CIR aerial photography was not obtained in 2012. Future monitoring of the secondary wetlands will continue according to the monitoring requirements as described in Section 4.0 Thresholds.

3.3 HYDROLOGICAL MONITORING

Several different types of hydrological data were collected during the 2012 monitoring efforts. The collected data, their sources, and any analyses performed are discussed below and included in Appendix III.

3.3.1 Groundwater Monitoring Wells

Permanent wells designed to measure groundwater levels before and during Project operation have been monitored by the District using the installed data loggers. A total of 23 monitoring wells were monitored during 2012. Water level readings were measured and recorded on a regular basis using an electronic datalogger. The collected data in 2012 have been graphed over time and are presented for each monitoring well in Section A of Appendix III.

3.3.2 Production Wells

The Project production wells that are pumped to provide raw water to the new water treatment plant during Project operation were monitored in 2012 using installed data loggers. The total production well pumping rates by month, the total volume pumped per month, and the average monthly pumping rates for each production well have been included in Tables 1 and 2 in Section B, Appendix III. These data will be evaluated and analyzed to provide corroborating information should any changes be detected in the other monitoring data.

3.3.3 Piezometers

Sixteen piezometers were installed in four wetlands in the Saunders County well field in 2005. Twelve of the piezometers were installed in May and four piezometers (located in the Phase I Wet Meadow Mitigation Site, WM-1, adjacent to the Wet Meadow) were installed in late October. In May of 2009, two additional piezometers were installed in the Phase I Wet Meadow Expansion Mitigation Site, WM-2, for a total of 18 piezometers. As described in Section 2.3.3, eight of the piezometers were reinstalled adjacent to their original position in July of 2010. The collected data from the 2012 monitoring efforts have been graphed over time and are presented in Section C, Appendix III.

The piezometers installed in PEM W-25 (PZ-01 through PZ-04), PFO W-5 (PZ-05 through PZ-08), PEM WM-1 (PZ-13 through PZ-16), and PEM WM-2 (PZ-17 and PZ-18) are all located above the shallow clay layer associated with the Wet Meadow (Figures 1, 3, and 4; Section C, Appendix III). Piezometers installed in PEM W-100 (PZ-09 through PZ-12) are outside of both the Wet Meadow boundary and the perched water table located above the shallow clay layer (Figure 2, Section C, Appendix III). These readings are used to provide corroborating hydrological evidence should any changes be detected in the wetland vegetation data.

3.3.4 Bathymetric Monitoring of Ponds

The post-operation bathymetric monitoring of ponds located in the Douglas County and Saunders County well fields and associated cones of depression was completed during 2012 as planned. The data collected from these monitoring efforts is presented in a separate report entitled the *2012 Annual Bathymetric Monitoring Report for the Ponds within the Well Fields and Cones of Depression* (Burns & McDonnell 2013). Pond monitoring is conducted to document the variation in each monitored pond's seasonal water surface elevation. The data presented in the bathymetric monitoring report will provide corroborating hydrological evidence should any changes be detected in the wetland vegetation data.

3.3.5 Other Hydrological Data

Additional hydrological data collected during the 2012 monitoring efforts included monthly total precipitation, monthly average ambient air temperature, and stream gauge data. The monthly total precipitation and monthly average ambient air temperature were both obtained from the weather station at Fremont Municipal Airport in Fremont, Nebraska. The 2012 precipitation and temperature data and the historical average monthly precipitation and temperature have been graphed over time; the graphs are included in Figures 1 and 2 (Section D, Appendix III).

Stream gauge data was obtained from the USGS stream gauge stations on the Platte and Elkhorn rivers. Platte River data was obtained from the recently installed stream gauge near Venice, Nebraska (USGS Stream Gauge No. 06796550). The installation of this stream gauge took place at the request of and through funding by the District. Data collected from this stream gauge is represented in Figure 3 (Section D, Appendix III). The Elkhorn River data was obtained from the stream gauge near Waterloo, Nebraska (USGS Stream Gauge No. 06800500). Data collected from this stream gauge is represented in Figure 4 (Section D, Appendix III).

* * * * *

4.0 THRESHOLDS

According to the Section 404 Permit conditions, the monitoring of wetlands in the well fields and cones of depression will take place during Project operation. To determine whether an impact is taking place at a given wetland, thresholds have been established in accordance with the baseline data that was collected. As monitoring data are evaluated after each sampling effort, thresholds are either met or not met, and the intensity of monitoring may be increased or decreased as a result. The wetland monitoring intensity levels and the process for determining whether a wetland has met the thresholds used to identify potential changes in the wetlands is described below.

4.1 LEVELS OF WETLAND MONITORING INTENSITY

A Wetland Monitoring Plan was developed and implemented in 2005 (Burns & McDonnell 2005a). This Monitoring Plan describes in detail the standard annual monitoring approach. During the years of baseline monitoring and the first several seasons of operational monitoring, the standard approach was considered an appropriate protocol. However, as monitoring continued, it became apparent that it may be beneficial to adjust the amount of data being collected based on whether impacts were being observed or not. If impacts have been documented ("yellow flags"), the intensity of monitoring increases. If no impacts have been documented ("green flags"), then the intensity of monitoring decreases. The five levels of monitoring intensity are listed below and described in detail in Figure 4-1.

- High-Intensity Annual Wetland Monitoring
- Standard Annual Wetland Monitoring
- Level 1 Decreased Annual Wetland Monitoring
- Level 2 Decreased Annual Wetland Monitoring
- Level 3 Decreased Annual Wetland Monitoring

4.2 METHOD FOR DETERMINING WETLAND IMPACTS

A series of evaluations and comparisons to the baseline data is being conducted after each sampling effort during Project operation to determine whether wetland impacts are occurring. The process for these evaluations is outlined in a flowchart included in Figure 4-2. A "green flag" on the chart indicates that no thresholds have been triggered and no significant impacts to wetlands due to Project operation have been observed. A "yellow flag" on the chart indicates that a change or an anomaly has been detected in either a vegetative index, the aerial photography, or in the hydrological monitoring. This anomaly may attributable to Project operation or it may be due to one of many naturally-occurring environmental or climatic factors. A "red flag" indicates that a threshold has been triggered and an impact to wetlands due to Project operation has likely occurred.

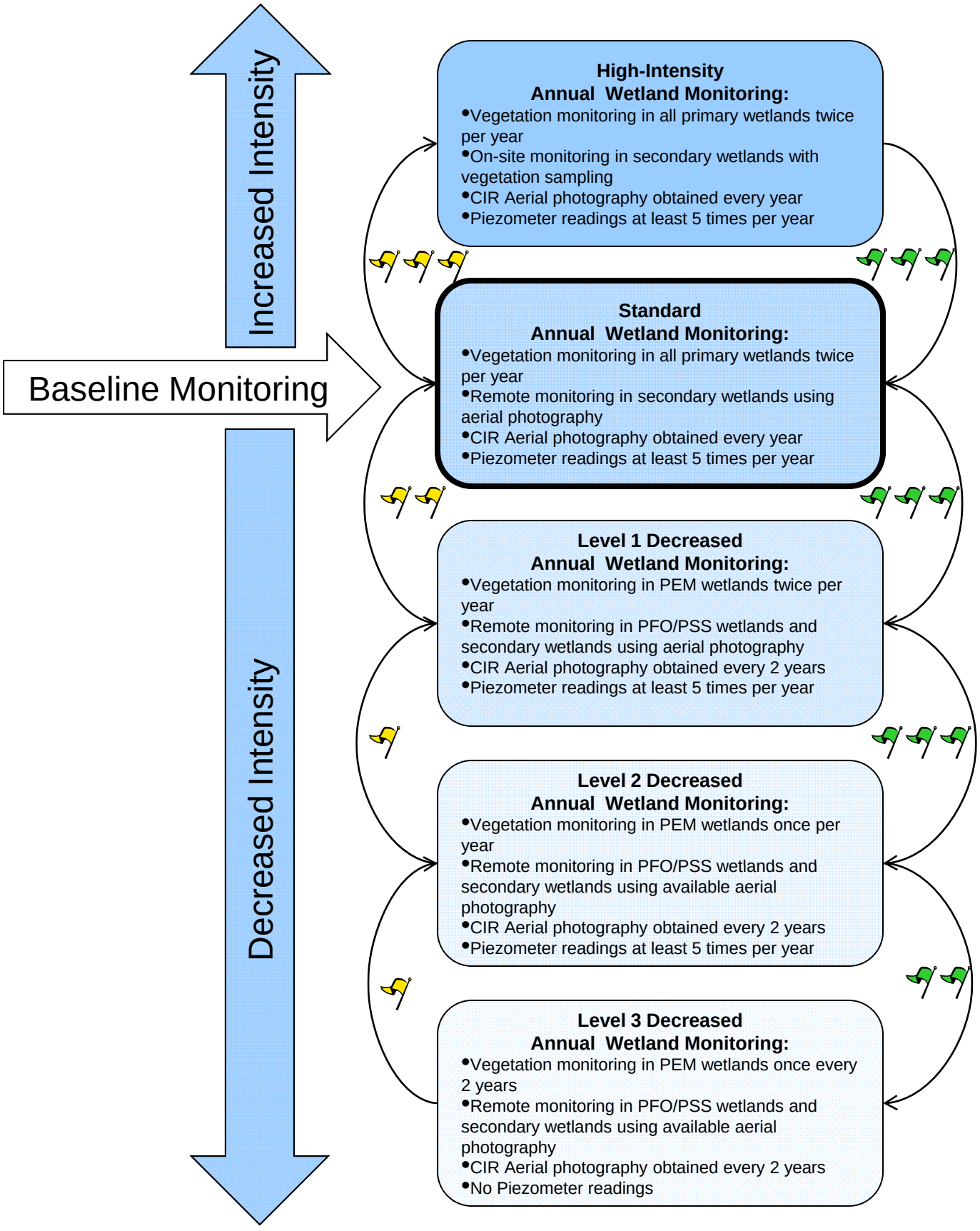


Figure 4-1

Levels of Wetland Monitoring Intensity

V:\OMAHAMUD\56799_2010_Monitoring\Monitoring-Wetlands\Threshold.Flowchart.pptx

Sampling Effort #1
Conduct **Standard Intensity** Wetland Monitoring and Analyze Data

Does the data analysis for this sampling effort meet one or more of the following criteria?:
- Increase in mean weighted average by more than 0.5 from baseline maximum
- A *significant difference* in three or more of the following indices: FQI, mean c-value, species diversity, or species richness
- Evident change from baseline variation visible on either CIR or natural color aerial photography

Yes

Sampling Effort #2
Increase Monitoring Intensity by One Level or Remain at Standard Intensity
Conduct Wetland Monitoring and Analyze Data

Does the data analysis for this sampling effort meet one or more of the following criteria?:
- Increase in mean weighted average by more than 0.5 from baseline maximum
- A *significant difference* in three or more of the following indices: FQI, mean c-value, species diversity, or species richness
- Evident change from baseline variation visible on either CIR or natural color aerial photography

Yes

****Potential Impact****
- Alert Corps and District of potential change
- Increase monitoring intensity to Standard Monitoring (if it had been decreased)
- Conduct detailed comparison to hydrology/climate data to identify potential cause for observed change

Sampling Effort #3
Increase to *Standard Monitoring Intensity*
Conduct Wetland Monitoring and Analyze Data

Does the data analysis for this sampling effort meet one or more of the following criteria?:
- Increase in mean weighted average by more than 0.5 from baseline maximum
- A *significant difference* in three or more of the following indices: FQI, mean c-value, species diversity, or species richness
- Evident change from baseline variation visible on either CIR or natural color aerial photography

Yes

****Wetland Impact****
Discussions between Corps and District to determine whether to:
- Take closer look at surrounding wetlands to determine if impact is isolated
- Increase monitoring to *High-Intensity Annual Monitoring*
- Consider providing additional wetland mitigation

No

No impact occurring, restart same level monitoring

No

Sampling Effort #2
Conduct Wetland Monitoring and Analyze Data

Does the data analysis for this sampling effort meet one or more of the following criteria?:
- Increase in mean weighted average by more than 0.5 from baseline maximum
- A *significant difference* in three or more of the following indices: FQI, mean c-value, species diversity, or species richness
- Evident change from baseline variation visible on either CIR or natural color aerial photography

No

Sampling Effort #3
Conduct Wetland Monitoring and Analyze Data

Does the data analysis for this sampling effort meet one or more of the following criteria?:
- Increase in mean weighted average by more than 0.5 from baseline maximum
- A *significant difference* in three or more of the following indices: FQI, mean c-value, species diversity, or species richness
- Evident change from baseline variation visible on either CIR or natural color aerial photography

Yes

No

No Impact Occurring
Reduce Intensity of Monitoring by One Level
(*Levels of Wetland Monitoring Intensity Chart*)
- 3 consecutive green flags = reduce from Standard to Level 1, or from Level 1 to Level 2 Reduced Monitoring
- 2 consecutive green flags = reduce from Level 2 to Level 3 Reduced Monitoring

Legend

= No impact occurring. Continue standard monitoring protocol.

= Impacts possible at this wetland. Continue monitoring until three consecutive sampling efforts show change.

= Impacts likely. District will initiate discussion with Corps.

Burns & McDonnell SINCE 1898

Figure 4-2
Flowchart for Determining Wetland Impacts

5.0 RESULTS

The following sections provide the results of the data analysis for each of the wetlands monitored during the 2012 effort. The complete set of data (figures, summary tables, ground photographs, and raw data sheets) for each monitored wetland in the well fields is available in Appendix I. In addition, a comprehensive species list of vegetation observed at the monitored wetlands between 2005 and 2012 is included in Appendix II. Finally, Appendix III contains all hydrological data collected and analyzed in graphic form.

The various vegetative indices, aerial photography, and other supporting hydrological data that are collected annually have been analyzed to compare 2012 data to baseline averages. To determine whether any differences from baseline averages are significant, further analysis is required to identify if an observed change to a wetland has taken place and if it would be indicative of a Project-induced impact. A discussion of the threshold analysis that was conducted for each wetland is included below.

5.1 WETLAND MONITORING IN THE WELL FIELDS

Data collected during monitoring of the wetlands in the well fields included qualitative vegetation data. In addition, hydrological data was collected for the area. The results of the data collection are presented in the following sections.

5.1.1 Vegetation Sampling

Three PEM wetlands (W-68, W-25, and W-100) were sampled in September of 2012 as part of the Level 2 decreased monitoring effort. Sampling did not take place in June in 2012 in accordance with the lowered monitoring intensity. September was chosen for the 2012 monitoring to provide a contrast in the sampling schedule after the June sampling in 2011. Table 5-1 shows the results of the various vegetative indices collected for each of the monitored wetlands in 2012. Detailed results for each wetland are included in the sections that follow.

Table 5-1: Summary of 2012 Wetland Vegetation Data Analysis

Wetland ID	Mean Weighted Average (WA_M)	Species Richness	Species Diversity	FQI	Mean C Value
	Fall 2012	Fall 2012	Fall 2012	Fall 2012	Fall 2012
W-68	2.42	32	16.03	18.05	3.30
W-25	2.61	26	14.97	10.95	2.24
W-100	3.98	5	2.36	2.00	1.00

5.1.1.1 PEM Wetland 68 – Douglas County

Wetland 68 is a PEM wetland located in Douglas County, Nebraska (Figure 1, Section A-1, Appendix I). The vegetation in this wetland was sampled using 3 transects, 12 gradsects, and 60 sample plots. Dominant species observed in this wetland during the 2012 monitoring efforts included sedge (*Carex* sp.), desert false indigo (*Amorpha fruticosa*), prairie cordgrass (*Spartina pectinata*), reed canarygrass (*Phalaris arundinacea*), and Kentucky bluegrass (*Poa pratensis*). Wetland 68 (excluding the upland gradsects) had a WA_M of 2.42 in the fall of 2012 (Table 5-2), indicating that it continues to be dominated by wetland vegetation. The baseline maximum threshold WA_M for W-68 is 2.78. The WA_M for fall 2012 remained below the baseline threshold as illustrated in Figure 2 in Section A-1 in Appendix I. This wetland contained an average of 94 percent native species and 34 percent invasive species in 2012. The FQI for this wetland during the same time period was 18.05, down in value from 26.90 in 2011. Tables 1 and 2 in Section A-2 of Appendix I contain a summary of the monitoring data and the complete species list from the 2012 monitoring effort.

Table 5-2: Wetland 68 Comparison of 2012 Vegetation Data to Baseline Averages

	Fall 2012	Baseline Mean	Baseline Low	Baseline High
WA_M	2.42	2.55	2.33	2.78
Species Richness	32	56.14	46.00	70.00
Species Diversity	16.03	20.43	16.63	24.29
Mean C Value	3.30	3.58	3.22	3.83
FQI	18.05	24.62	22.50	28.89

The WA_M for the 2012 fall sampling effort did not increase by 0.5 or more from the baseline maximum WA_M of 2.78 as shown above in Table 5-2 and in Figure 2 in Appendix I, Section A-1. However, the calculated values for FQI, mean c-value, species diversity, and species richness were all near or below the lowest observed baseline values (Table 5-2). The statistical analysis of 2012 indicated statistically significant changes from baseline averages in the species richness, mean C Value, and FQI values using the repeated measures ANOVA. No significant statistical change was noted for species diversity. The data gathered during the operational monitoring efforts in 2012 resulted in a yellow flag as outlined in Figure 4-2 or illustrated in Table 5-3. However, due to the extreme drought conditions present in the region during the late summer and fall of 2012 as documented by the monthly historical Palmer Z Drought Indices for 2012, as provided by the National Climatic Data Center of the National Oceanic and Atmospheric Administration (NOAA), it is recommended that monitoring at W-68 continue consistent with the current methodology for Level 2 Decreased Monitoring for the next monitoring effort.

Following the 2013 monitoring in June, an assessment will be made whether to continue with Level 2 Decreased Monitoring or increase the monitoring intensity to Level 1.

Table 5-3: Record of Thresholds Evaluation by Sampling Season for Wetland 68

Sampling Season	Increase in WA_M by more than 0.5?	A *significant difference* in three or more of the following indices?				Change visible on aerial photos?	Flag?	Monitoring Intensity Change?
		FQI	mean c-value	species diversity	species richness			
Sept. 2008	No	No	No	No	No	No		No
June 2009	No	No	No	Yes	Yes	No		No
Sept. 2009	No	No	No	No	No	No		Yes - Decrease to Level 1
June 2010	No*	No	No	Yes	Yes	No		No - Remain at Level 1
Sept. 2010	No	No	No	No	No	NA		No - Remain at Level 1
June 2011	No	No	No	No	No	No		Yes – Decrease to Level 2
Sept. 2012	No	Yes	Yes	No	Yes	NA		No – Remain at Level 2

* = A significant decrease in WAM occurred, indicating that the wetland was wetter than baseline average.

5.1.1.2 PEM Wetland 25 – Saunders County

Wetland 25 is a PEM wetland located in Saunders County, Nebraska (Figure 1, Section B-1, Appendix I). The vegetation in this wetland was sampled using 3 transects, 15 gradsects, and 75 sample plots. Dominant species observed in this wetland during the 2012 monitoring efforts included sawtooth sunflower (*Helianthus grosseserratus*), reed canarygrass, sedge, and Kentucky bluegrass. Wetland 25 (excluding the upland gradsects) had a WA_M of 2.61 in the fall of 2012 (Table 5-4), indicating that it continues to be dominated by wetland vegetation. The baseline maximum threshold WA_M prior to Project operation for W-25 is 2.52. The WA_M for 2012 exceeded the baseline threshold as illustrated in Figure 2 in Section B-1 in Appendix I. This wetland contained an average of 92 percent native species and 50 percent invasive species in 2012. The FQI for this wetland during the same time period was 10.95, a considerable drop from the 2011 value of 17.30. Tables 1 and 2 in Section B-2 of Appendix I contain a summary of the monitoring data and the complete species list from the 2012 monitoring effort.

Table 5-4: Wetland 25 Comparison of 2012 Vegetation Data to Baseline Averages				
	Fall 2012	Baseline Mean	Baseline Low	Baseline High
WA_M	2.61	2.28	1.93	2.52
Species Richness	26	48.71	28.00	66.00
Species Diversity	14.97	22.71	16.63	24.29
Mean C Value	2.24	3.18	2.77	3.69
FQI	10.95	20.96	14.42	25.85

The WA_M for the 2012 sampling season did not increase by 0.5 or more from the baseline maximum WA_M of 2.52 as shown in Table 5-4 and in Figure 2 in Appendix I, Section B-1. The statistical analysis using the repeated measures ANOVA indicated statistically significant changes from baseline averages in each of the four indices being evaluated in 2012 (Table 5-5). Each metric was below the baseline low value in 2012, likely a direct result of the extreme drought in the region. The data gathered during the operational monitoring efforts in 2012 resulted in a yellow flag as outlined in Figure 4-2 or illustrated in Table 5-5. However, due to the extreme drought conditions present in the region during the late summer and fall of 2012, it is recommended that monitoring at W-25 continue consistent with the current methodology for Level 2 Decreased Monitoring for the next monitoring effort. Following the 2013 monitoring in June, an assessment will be made whether to continue with Level 2 Decreased Monitoring or increase the monitoring intensity to Level 1.

Table 5-5: Record of Thresholds Evaluation by Sampling Season for Wetland 25								
Sampling Season	Increase in WA_M by more than 0.5?	A *significant difference* in three or more of the following indices?				Change visible on aerial photos?	Flag?	Monitoring Intensity Change?
		FQI	mean c-value	species diversity	species richness			
Sept. 2008	No	No	No	No	No	No		No
June 2009	No	No	No	No	No	No		No
Sept. 2009	No	No	Yes	No	No	No		Yes - Decrease to Level 1
June 2010	No	No	No	Yes	Yes	No		No - Remain at Level 1
Sept. 2010	No	Yes	Yes	No	No	NA		No - Remain at Level 1
June 2011	No	Yes	Yes	No	No	No		Yes – Decrease to Level 2
Sept. 2012	No	Yes	Yes	Yes	Yes	NA		No – Remain at Level 2

5.1.1.3 PEM Wetland 100 – Saunders County

Wetland 100 is a PEM wetland located in Saunders County, Nebraska (Figure 1, Section C-1, Appendix I). The vegetation in this wetland was sampled using 3 transects, 11 gradsects, and 55 sample plots. Only five species demonstrating live growth were observed in this wetland during the 2012 monitoring effort. Those species were redroot amaranth (*Amaranthus retroflexus*), annual ragweed (*Ambrosia artemisiifolia*), marijuana (*Cannabis sativa*), Canadian horseweed (*Conyza canadensis*), and American elm (*Ulmus americana*). Wetland 100 (excluding the upland gradsects) had a WA_M of 3.98 in the fall of 2012 (Table 5-6), indicating that it was dominated by upland vegetation. The baseline maximum threshold WA_M prior to Project operation for W-100 is 2.96. The WA_M for fall of 2012 greatly exceeded the baseline threshold as illustrated in Figure 2 in Section C-1 in Appendix I. This wetland contained an average of 80 percent native species and 80 percent invasive species in 2012. The FQI for this wetland during the same time period was 2.00, implying a low ecological value. Tables 1and 2 in Section C-2 of Appendix I contain a summary of the monitoring data and the complete species list from both of the 2012 monitoring effort.

Table 5-6: Wetland 100 Comparison of 2012 Vegetation Data to Baseline Averages

	Fall 2012	Baseline Mean	Baseline Low	Baseline High
WA_M	3.98	2.40	1.71	2.96
Species Richness	5	28.71	23.00	33.00
Species Diversity	2.36	14.13	11.34	17.09
Mean C Value	1.00	3.41	3.00	3.72
FQI	2.00	16.42	14.70	18.33

The WA_M for the 2011 sampling season increased by more than 0.5 from the baseline maximum WA_M of 2.96 as shown in Table 5-6 and in Figure 2 in Appendix I, Section C-1. The statistical analysis, using the repeated measures ANOVA, indicated statistically significant changes in all indices compared to baseline averages in 2012 (Table 5-7). Due to the extreme drought conditions and overall lack of living vegetation at W-100 during the 2012 monitoring effort, it is no surprise that the vegetation calculations were well below the lowest values recorded during baseline or operational monitoring. It is recommended that monitoring at W-100 continue consistent with the current methodology for Level 2 Decreased Monitoring for the next monitoring effort. Following the 2013 monitoring in June, an assessment will be made whether to continue with Level 2 Decreased Monitoring or increase the monitoring intensity to Level 1.

Table 5-7: Record of Thresholds Evaluation by Sampling Season for Wetland 100

Sampling Season	Increase in WA_M by more than 0.5?	A *significant difference* in three or more of the following indices?				Change visible on aerial photos?	Flag?	Monitoring Intensity Change?
		FQI	mean c-value	species diversity	species richness			
Sept. 2008	No*	No	No	No	No	No		No
June 2009	No*	No	No	No	No	No		No
Sept. 2009	No	No	No	No	No	No		Yes - Decrease to Level 1
June 2010	No	No	No	No	No	No		No - Remain at Level 1
Sept. 2010	No	Yes	Yes	No	No	NA		No - Remain at Level 1
June 2011	No	Yes	Yes	No	Yes	No		Yes - Decrease to Level 2
Sept. 2012	Yes	Yes	Yes	Yes	Yes	NA		No – Remain at Level 2

*** = A significant decrease in WAM occurred, indicating that the wetland was wetter than baseline average.**

5.1.2 False-color Infrared (CIR) Aerial Photography

As mentioned above, no CIR aerial photography was scheduled or obtained in 2012. Aerial photography will again be obtained in 2013 consistent with schedule described in Figure 4-2 for Level 2 reduced monitoring.

5.2 WETLAND MONITORING IN THE CONES OF DEPRESSION

As stated above, natural color and CIR aerial photography were not obtained in 2012. As such, no analysis of the wetlands within the cones of depression (and outside of the well fields) was conducted in 2012. Aerial photography will again be obtained in 2013 consistent with schedule described in Figure 4-2 for Level 2 Decreased Monitoring. Analysis of the 2013 aerial photography will be included in the 2013 annual monitoring report.

5.3 HYDROLOGICAL MONITORING

Several different types of hydrological data were collected during the 2012 monitoring efforts. These collected data have been analyzed and the results are discussed below and included in Appendix III.

5.3.1 Groundwater Monitoring Wells

The groundwater monitoring well data collected for 2012 have been graphed and are presented for each monitoring well in Figures 1 through 23 in Section A of Appendix III. Readings from these monitoring wells provide additional hydrological data for comparison should any changes be detected in the wetland vegetation data. All of the monitored wells showed lower elevations in late summer and fall 2012 compared to the same period in 2011. The lower 2012 elevations are likely the result of the drought conditions during this period.

5.3.2 Production Wells

The Project production wells are monitored using installed data loggers. The total production well pumping rates by month, the total volume pumped per month, and the average monthly pumping rates for each production well have been included in Tables 1 and 2 in Section B, Appendix III.

Project operation of the production wells in the well fields occurred throughout 2012, the fourth full year of operation. As in past years, pumping occurred well below capacity. Extreme drought conditions impacted operation of the well fields. Due to widespread groundwater drawdowns and restrictions affecting the City of Lincoln's well field located just downstream of the Platte West well fields, the District chose to voluntarily restrict pumpage in 2012. Restrictions included an overall pumpage limitation of 50 MGD of maximum withdrawal beginning in mid-July, decreasing the maximum withdrawal to 40 MGD on August 1st, and continuing with that restriction through October 18th. Maintenance issues at the District's other facilities forced the restriction to be relaxed during the first two weeks of September, although September's withdrawal was only slightly above the 40 MGD limit (41.37 MGD). As a result, in spite of the extreme drought conditions, annual production (January through November) decreased slightly in 2012 compared to 2011; this decrease in average daily production was approximately two million gallons per day. On average, approximately 73 percent of the total production came from the Saunders County well field with the remainder produced from Douglas County. It is important to note that Project operation is occurring, but not at full capacity.

5.3.3 Piezometers

Eighteen piezometers have been installed and are being monitored in the Saunders County well field. The collected data from the 2012 monitoring efforts have been graphed over time and are presented in Section C, Appendix III. Many of the 2012 piezometer readings were again within inches of the bottom of the piezometers and held steady over multiple readings. The bottom elevation of each piezometer is included in the legend of each figure in Section C, Appendix III. Based on the consistent readings over months indicated by many of the piezometers, it is likely that the readings are the result of residual moisture and sediment retained in the tips of the piezometers rather than an accurate measurement of the local water table elevation. In these cases, the actual water table elevation is assumed to be lower than the reported level. In general, water level elevations taken from the piezometers were lower than those observed during baseline conditions for each of the wetlands monitored.

5.3.4 Bathymetric Monitoring of Ponds

The post-operation bathymetric monitoring of ponds located in the Douglas County and Saunders County well fields and associated cones of depression was completed during 2012 as planned. In 2012, most of

the pond water levels were highest in March before gradually dropping in August, September, and October. Of the 47 ponds monitored in 2012, seven ponds showed a statistically significant difference in water level elevation when comparing the 2009 through 2012 operational data to the baseline data (August 2006 through March 2008). Of those seven ponds, six were significantly lower than baseline levels and one was significantly higher. Detailed analysis of these monitoring efforts is included in a separate report entitled the *2012 Annual Bathymetric Monitoring Report for the Ponds within the Well Fields and Cones of Depression* (Burns & McDonnell 2012).

5.3.5 Other Hydrological Data

Additional hydrological data collected during the 2012 monitoring efforts included monthly total precipitation, monthly average ambient air temperature, and stream gauge data. The monthly precipitation from January 1 through December 2012 was generally below the monthly historical averages with the exception of February and May, during which the monthly total exceeded the historical monthly average by less than one inch (Appendix III, Section D). Almost no precipitation occurred in July and September. Overall, the January through December 2012 recorded precipitation total was 16.1 inches, while the annual historical average during the same period was 28.4 inches, indicating a much drier than normal year (The Weather Channel 2012). Historically, the amount of precipitation increases from January to a peak in June, declines to a plateau in late summer, and continues to decline through the end of the year.

Average ambient air temperature in 2012 fell within the expected monthly high and low temperature range based on historical averages, except in March (Figure 2, Section D, Appendix III). Additionally, the average monthly temperature in January through July, November, and December 2012 was closer to the historical average monthly high temperature than to the historical average monthly low temperature. Average monthly temperatures ranged between 28 °F and 83 °F from January 1 through December 31, 2012.

According to the monthly historical Palmer Z Drought Indices for 2012, the Project area experienced extreme drought conditions in July, August, and September. The Palmer Drought Indices integrate water supply (precipitation) with water demand (evapotranspiration as computed from temperature) in a soil moisture model (NOAA 2012).

Stream gauge data was obtained from the USGS stream gauge stations on the Platte and Elkhorn rivers. Historically, stream elevations are highest in the spring and lowest in late summer and early fall (Figures 3 and 4, Section D, Appendix III). In 2012, the mean stream elevation of the Platte River was below the

historic monthly mean stream elevation during all months, except February when the 2012 elevation was approximately equal to the historic mean elevation. The peak recorded in February can likely be attributed to the higher than average monthly precipitation in February. In July and August 2012, the mean stream elevation of the Platte River was just over one foot lower than the historic mean stream elevation during the same months. The low stream elevations during this period can be attributed to the low precipitation levels and the high ambient temperature readings.

Mean stream elevations in the Elkhorn River generally followed the pattern described above for the Platte River; the mean stream elevation throughout 2012 was below the historic mean stream elevation except in July. The July 2012 stream elevation was approximately one foot higher than the July historical average. This increase in stream level does not correlate to the 2012 precipitation data for the area.

* * * * *

6.0 DISCUSSION AND RECOMMENDATIONS

The goal of monitoring wetlands within the Douglas County and Saunders County well fields and associated cones of depression is to evaluate the impact that operation of the Project may have on the existing wetlands. To accomplish this goal, a monitoring approach consisting of a systematic, multi-tiered vegetation sampling procedure has been developed and implemented. Monitoring efforts conducted from the inception of the monitoring program in 2005 through this year's monitoring effort (in 2012) are discussed in the sections below. A review of the thresholds analysis and the current and proposed level of monitoring efforts proposed for next year are also included below.

6.1 DISCUSSION

The following sections discuss the 2012 wetland monitoring efforts for wetlands in the well fields and cones of depression.

6.1.1 Wetland Monitoring in the Well Fields

Data obtained during the 2012 sampling season have been analyzed and the results are included in Appendix I. In 2012, the Level 2 Decreased Annual Wetland Monitoring protocol was conducted for the second year. This required a single sampling of the wetland vegetation in September to complement the June 2011 monitoring which occurred during the first year of Level 2 Decreased Monitoring.

For the first time since Project operation began in August 2008, two of the three monitored wetlands (W-25 and W-100) showed calculated WA_M values above the recorded baseline maximum values. Additionally, all three of the monitored wetlands showed statistically significant differences in three or more of the other vegetative indices used to further assess the data. As explained above in Section 5.3.2, 2012 pumping in the well fields occurred at a lower rate than in 2011. As such, the extreme drought conditions in the region coupled with monitoring occurring only in the fall likely had a significant impact on the observed vegetation indices.

The WA_M calculated for each wetland and each sampling season since monitoring began have been graphed and are included as Figure 5 in Appendix I. This vegetative parameter has been accepted as the most likely indicator of change in the monitored wetlands and these graphs provide a useful visual reference of the WA_M over time. A trend line has also been calculated for each wetland. The trend line for W-68 in Douglas County has a negative slope following the latest monitoring effort, which indicates that the wetland is actually trending towards being wetter rather than drying out as might be anticipated given the operation of the Project. Prior to 2012, the trend lines of W-25 and W-100 in Saunders County also had negative or nearly level slopes. However, following a summer of extreme drought conditions

and resulting higher 2012 WA_M values calculated for W-25 and W-100, both trend lines are currently positive, trending slightly toward drier conditions.

The statistical analysis of the other vegetative parameters also indicated that the monitored wetlands were experiencing significant differences in 2012 with all indices (except species diversity at W-68) falling outside of statistical normality. Nearly all values for these indices were near or below baseline low values indicating poor species quantity and quality at the wetlands. For each of these wetlands, monitoring will continue in June 2013. A careful evaluation of this data will be rapidly conducted to determine whether the trends continue or if vegetation has had an opportunity to rebound following the drought in 2012. A decision will be made on future monitoring following the June 2013 effort.

6.1.2 Wetland Monitoring in the Cones of Depression

No aerial photography was obtained in 2012 consistent with the protocol developed for Level 2 Decreased Monitoring. As such, no analysis was conducted in 2012 for the wetlands in the Cones of Depression. Aerial photography will once again be obtained in 2013 and analyses will be conducted in next year's annual monitoring report. No change in the monitoring protocol for the wetlands in the cones of depression is recommended until review of the 2013 aerial photography is completed.

6.1.3 Hydrological Monitoring

In addition to the wetland monitoring efforts, several different types of hydrological data have been gathered and analyzed as part of the ongoing monitoring efforts. These hydrological data include groundwater monitoring wells, piezometers, monthly average precipitation, monthly average ambient air temperature, and stream gauge data for the Platte and Elkhorn Rivers. Each of these pieces of data remains appropriate and relevant to the monitoring effort and no change to the collections or analysis of this data is recommended at this time.

6.2 RECOMMENDATIONS

This report summarizes the 2012 wetland monitoring efforts. As a result of the conditions observed in the wetlands discussed above, and in particular due to the extreme drought conditions experienced in the region in 2012, it is recommended that wetland monitoring efforts in 2013 continue without changes to the methodology at this time. Level 2 decreased monitoring is conducted once annually and will rotate between the June and September sampling seasons. Since 2012 vegetation monitoring took place in September, wetland monitoring will be conducted in June 2013 at the emergent wetlands only. Data gathered during the June 2013 monitoring effort will be quickly processed, analyzed, and compared with other local climatic and hydrologic conditions to try to ascertain if the emergent wetlands are recovering

from the drought conditions. Additional monitoring may be necessary in the fall of 2013 based on this analysis. A review of the June 2013 analysis will be completed with the Corps and the District and a protocol will be decided upon prior to September 2013. Options are anticipated to include no additional monitoring in 2013 (Level 2 reduced monitoring complete for the year) or an increase in the monitoring protocol to Level 1 reduced monitoring which would include both spring and fall monitoring efforts at the emergent wetlands. Regardless of the June analysis, aerial photography will be flown in 2013 and all hydrological data will again be collected and analyzed. Data collected in 2013 will continue to be compared to the baseline data in an attempt to determine the effects, if any, of Project operation.

* * * * *

7.0 REFERENCES

Burns & McDonnell. 2004. *Final Wetland Delineation Report for the Well Fields*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. December.

--------- 2005a. *Wetland Monitoring Plan*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. July.

--------- 2005b. *Final Wetland Delineation Report for the Cones of Depression*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. February.

--------- 2005c. *Bathymetric Evaluation and Monitoring of Ponds Within the Cones of Depression – Douglas and Saunders Counties, Nebraska*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2005d. *Mitigation Plan for Wetland Impacts – Phase I*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. August.

--------- 2006a. *2005 Annual Wetland Monitoring Report*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2006b. *2005 Annual Bathymetric Monitoring Report for the Ponds Within the Well Fields and Cones of Depression*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2007a. *2006 Annual Wetland Monitoring Report*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2007b. *2006 Annual Bathymetric Monitoring Report for the Ponds Within the Well Fields and Cones of Depression*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2007c. *Mitigation Plan for Wetland Impacts – Phase II*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. November.

--------- 2008. *2007 Annual Wetland Monitoring Report*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2009. *Baseline Wetland Monitoring Report*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

--------- 2013. *2013 Annual Bathymetric Monitoring Report for the Ponds within the Well Fields and Cones of Depression*. Platte West Water Production Facilities Project. Prepared for Metropolitan Utilities District. January.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1*, U.S. Army Corps of Engineers, Waterways Experiment Station. Vicksburg, MS.

Environmental Law Institute. 2004. *Measuring Mitigation: A Review of the Science for Compensatory Mitigation Performance Standards*. Washington, DC.

Federal Interagency Committee for Wetland Delineation. 1989. *Federal Manual for Identifying and Delineating Jurisdictional Wetlands.* U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service. Washington, D.C. Cooperative Technical Publication.

Greig-Smith, P. 1983. *Quantitative Plant Ecology.* University California Press, Berkeley, CA.

HDR Engineering, Inc. 2011. *2010 Nebraska Ordnance Plant Groundwater Report*, Metropolitan Utilities District Well Field, Nebraska. January.

Lichvar, Robert W. and Kartesz, John T. 2009. North American Digital Flora: National Wetland Plant List, Version 3.0 (http://rsgisias.crrel.usace.army.mil/NWPL/index.html). U.S. Army Corps of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Labratory, Hanover, NH, and BONAP, Chapel Hill, NC.

Rolfsmeier, S. and G. Steinauer. 2003. *Vascular Plants of Nebraska (Ver. I).* Nebraska Natural Heritage Program. Nebraska Game and Fish Commission, Lincoln, NE.

Simpson, E.H. 1949. *Measurement of Diversity.* Nature (London) 163: 688.

Streever, B. 1999. *Examples of Performance Standards for Wetland Creation and Restoration in Section 404 Permits and an Approach to Developing Performance Standards.* WRP Technical Notes Collection (TN WRP WG-RS-3.3). U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Taylor, T.J. and L.D. Krueger, eds. 1997. *Mitigation Guidelines for Nebraska's Eastern Saline Wetlands.* Prepared for the Eastern Saline Wetlands Interagency Study Project.

Tiner, R.W. 1999. *Wetland Indicators: A Guide to Wetland Identification, Delineation, and Mapping*. Lewis Publishers, Boca Raton, FL.

U.S. Army Corps of Engineers. 2003. Section 404 Permit (Number 199910085) for the Platte West Water Production Facilities Project. Issued May 16, 2003.

U.S. Army Corps of Engineers. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest; Region (Version 2.0)*

U.S. Environmental Protection Agency. 2002. *Methods for Evaluating Wetland Condition: Using Vegetation to Assess Environmental Conditions in Wetlands.* Office of Water, US Environmental Protection Agency, Washington, DC. EPA-822-R-02-020.

USDA. 2012. *The PLANTS Database* (http://plants.usda.gov, accessed multiple times in 2012). National Plant Data Center, Baton Rouge, LA.

The Weather Channel. 2012. *Monthly Averages for Fremont, NE*. http://www.weather.com/outlook/health/fitness/wxclimatology/monthly/graph/USNE0191

Weather Underground. 2012. History for Fremont, Nebraska. http://www.wunderground.com

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APPENDIX I - WETLAND MONITORING DATA FOR THE DOUGLAS COUNTY AND SAUNDERS COUNTY WELL FIELDS (FIGURES, TABLES, PHOTOGRAPHS, DATA SHEETS)

APPENDIX I - SECTION A

PEM WETLAND 68, DOUGLAS COUNTY WELL FIELD WETLAND MONITORING DATA

TABLE OF CONTENTS

SECTION A-1

FIGURES

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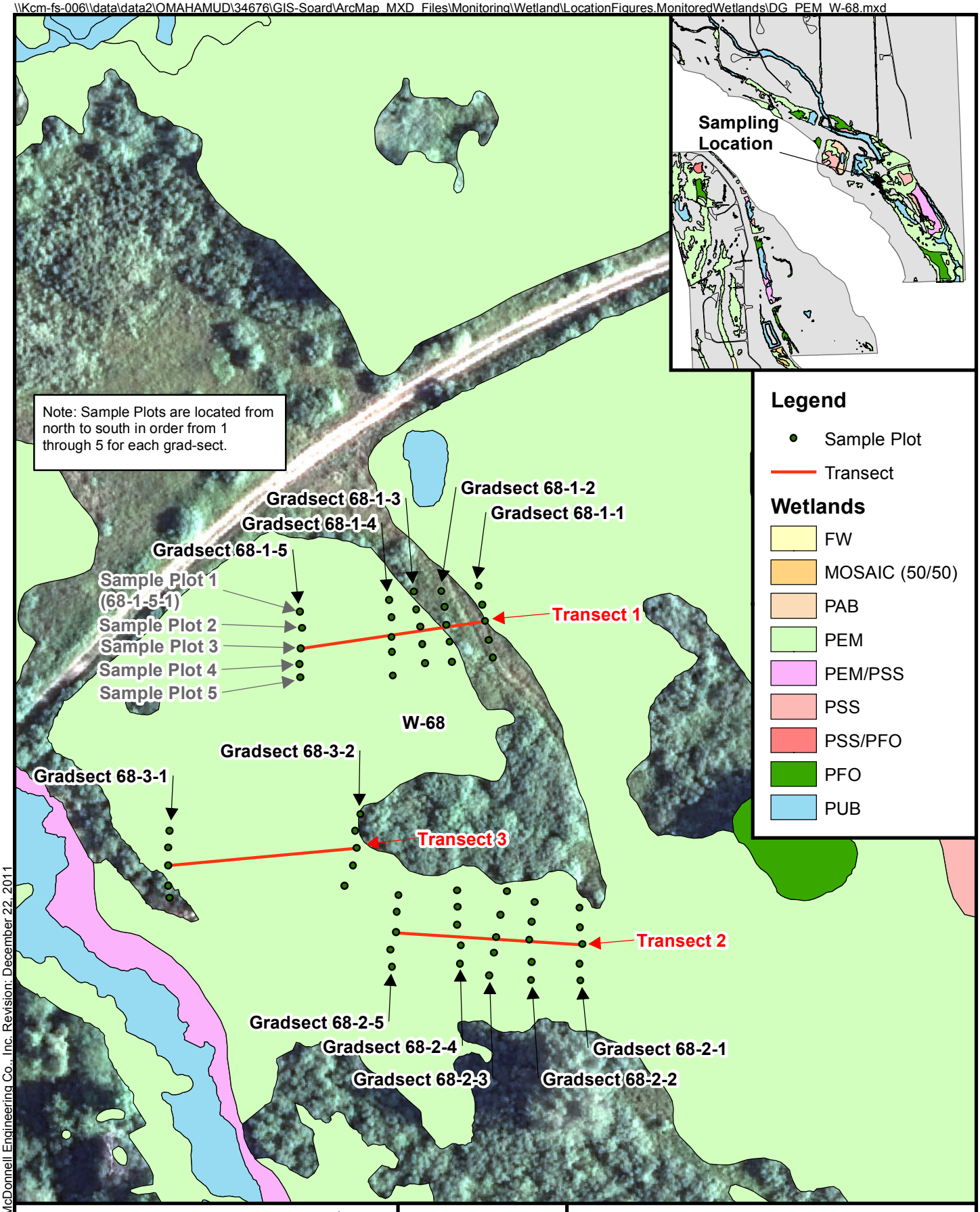


Burns & McDonnell SINCE 1898

Figure 1
Location Map for
PEM Wetland 68
Douglas County Wellfield
Metropolitan Utilities District

Figure 2 Mean Weighted Average of Wetland Gradsects Compared to the Baseline Threshold in Wetland-68

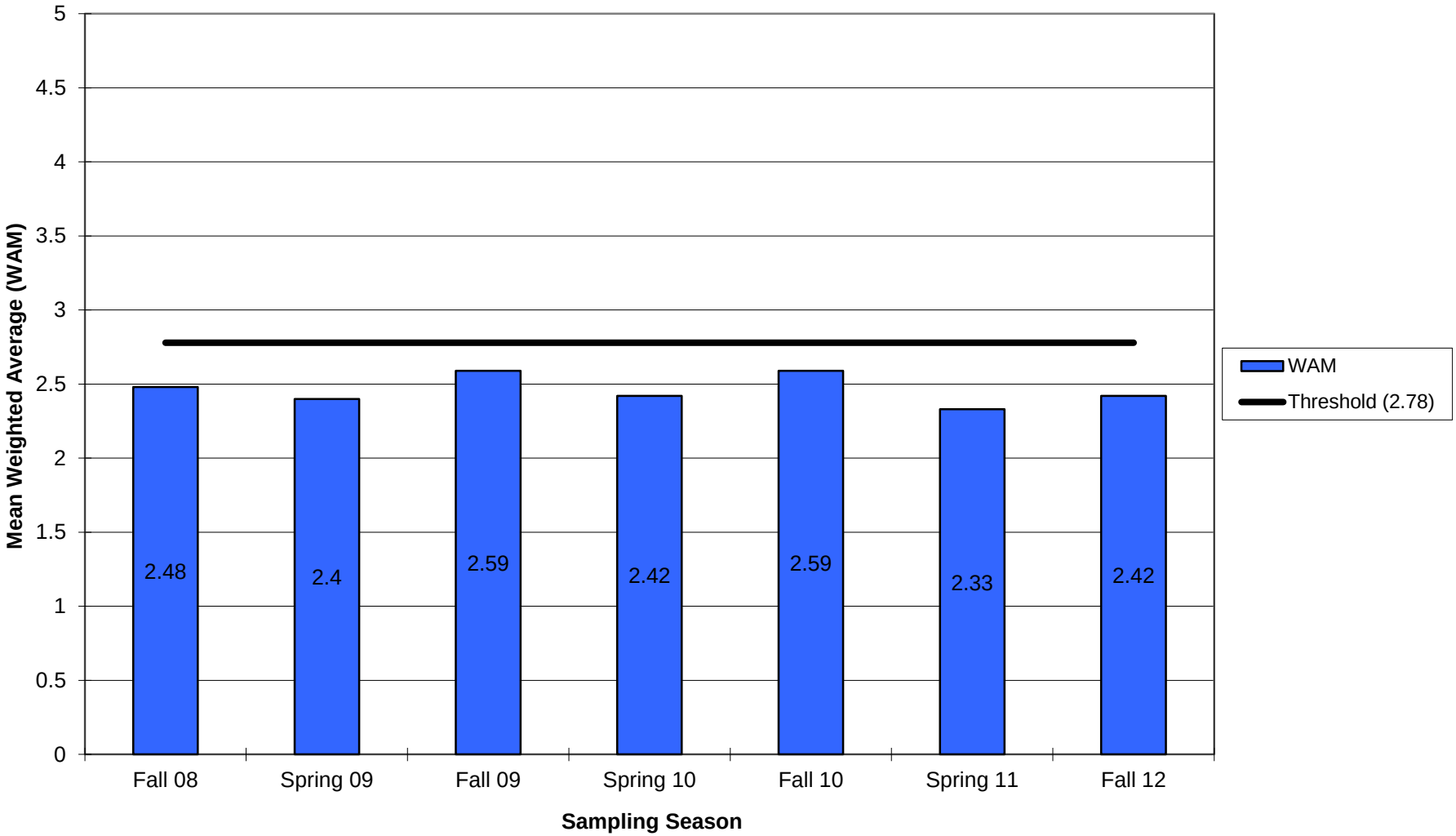
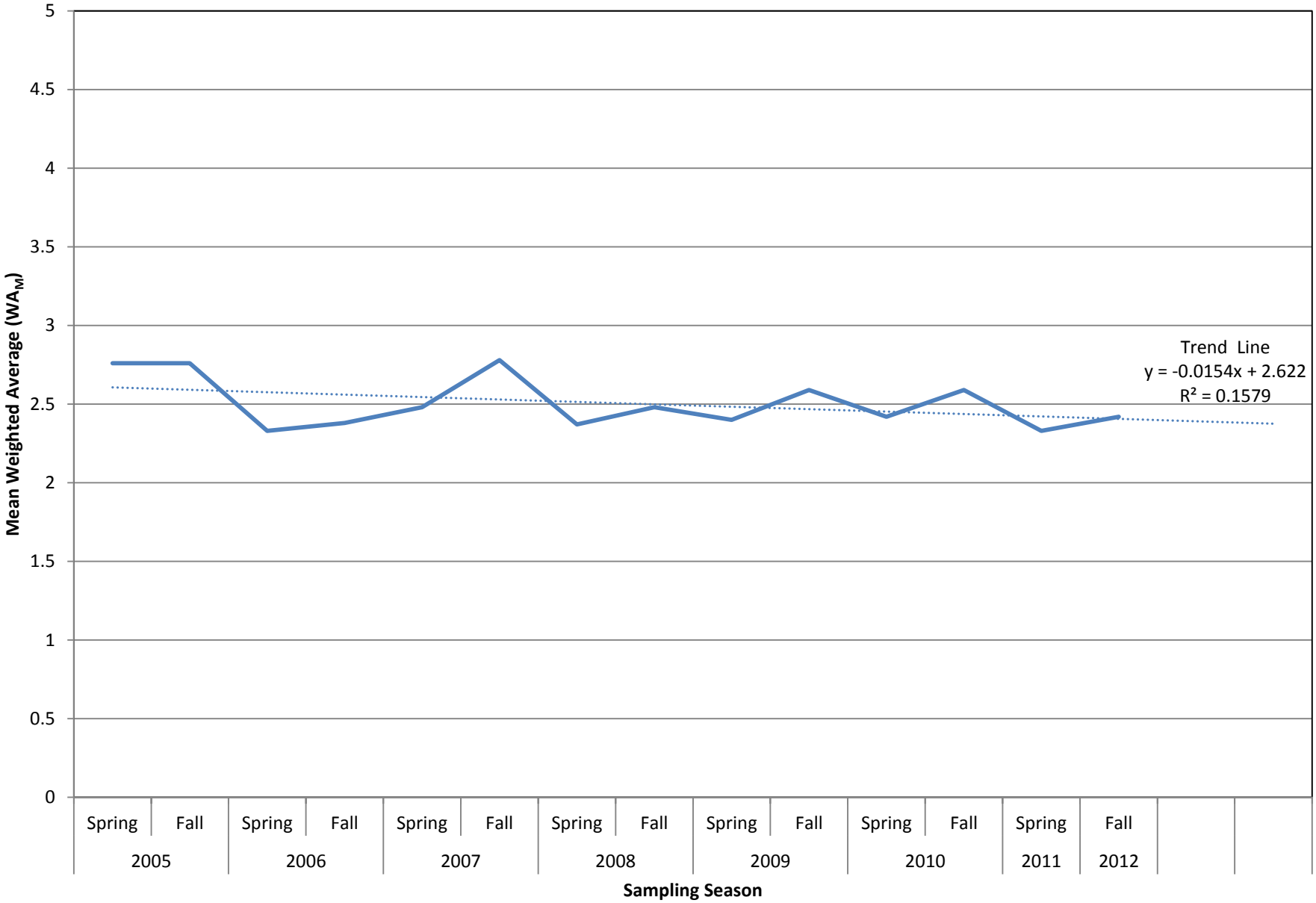


Figure 3 Mean Weighted Average of Wetland 68 Over Time



SECTION A-2

TABLES

Table 1 Summary of Wetland Monitoring Data for Wetland 68

Wetland Name: **W-68**
Wetland Type: **PEM**
County: **Douglas**

Number of Transects/Macroplots: **3**
Number of Gradsects: **12**
Number of Sample Plots: **60**
Number of Wetland Sample Plots: **50**

Sampling Effort: **2012 Fall**

Weighted Average: **2.42**
Species Richness: **32**
Species Diversity: **16.03**
FQI: **18.05**

Percent Native Species: **94**
Percent Invasive Species: **34**
Percent Perennial/Biennial/Annual Species: **88 / 0 / 16**
Mean C-Value: **3.30**

Dominant Species:

Scientific Name	Common Name	Wetland Indicator Status	Percent Cover per Wetland
Amorpha fruticosa	Desert false indigo	OBL	12.1
Carex sp. 1	Sedge	--	13.95
Phalaris arundinacea	Reed canarygrass	FACW+	9.7
Poa pratensis	Kentucky bluegrass	FACU	9.3
Spartina pectinata	Prairie cordgrass	FACW	10.25

Table 2 Species List and Vegetative Characteristics for Wetland 68

Report generated:
Friday, November 16, 2012

Sampling Effort: **2012 Fall**

Scientific Name	Common Name	Wetland Indicator Status[1]	Ecological Index[2]	C-Value	Native Status	Invasive?	Frequency[3]	Average Percent Cover[4]
Ambrosia artemisiifolia	Annual ragweed	FACU	4	0	Native	☑	1	0.30
Amorpha fruticosa	Desert false indigo	OBL	1	5	Native	☑	22	12.10
Andropogon gerardii	Big bluestem	FAC-	3	5	Native	☐	1	0.30
Boehmeria cylindrica	Smallspike false nettle	OBL	1	6	Native	☐	4	1.65
Calystegia sepium	Hedge false bindweed	FAC	3	1	Native & Introduced	☑	1	0.05
Carex cristatella	Crested sedge	FACW	2	5	Native	☐	1	0.75
Carex sp. 1	Sedge	--	3		Native	☐	17	13.95
Eleocharis erythropoda	Bald spikerush	OBL	1	5	Native	☐	1	0.75
Elymus virginicus	Virginia wildrye	FAC	3	4	Native	☐	2	0.60
Erechtites hieraciifolia	American burnweed	FAC	3	1	Native	☐	2	1.05
Helianthus grosseserratus	Sawtooth sunflower	FACW	2	4	Native	☑	21	5.45
Leersia oryzoides	Rice cutgrass	OBL	1	4	Native	☐	2	1.05
Lycopus americanus	American water horehound	OBL	1	4	Native	☑	1	0.30
Medicago lupulina	Black medick	FAC	3		Introduced	☑	2	0.10
Muhlenbergia schreberi	Nimblewill	FACU	4	0	Native	☑	4	0.70
Phalaris arundinacea	Reed canarygrass	FACW+	2	0	Native	☑	10	9.70
Phragmites australis	Common reed	FACW	2		Native	☑	3	1.60
Physalis longifolia	Longleaf groundcherry	NL	3	0	Native	☐	2	0.10

1 = OBL - obligate; FACW - facultative wet; FAC - facultative; FACU - facultative upland; UPL - upland; NI - no indicator

2 = Ecological Index values correspond to the wetland indicator status for each species

3 = Frequency is the total number of plots in which the species was identified

4 = Average percent cover is calcuated from the coverages estimated during this monitoring effort.

Table 2 Species List and Vegetative Characteristics for Wetland 68

Report generated:
Friday, November 16, 2012

Poa pratensis	Kentucky bluegrass	FACU	4		Native & Introduced	☑	23	9.30
Polygonum caespitosum	Oriental lady's thumb	NI	3		Introduced	☐	3	1.35
Salix interior	Sandbar willow	NL	3	3	Native	☐	1	0.30
Schoenoplectus pungens	Common threesquare	OBL	1	4	Native	☐	12	2.35
Schoenoplectus tabernaemont	Softstem bulrush	OBL	1	5	Native	☐	3	1.80
Solidago canadensis	Canada goldenrod	FACU	4	2	Native	☐	18	6.40
Solidago gigantea	Giant goldenrod	FACW	2	3	Native	☐	15	6.00
Spartina pectinata	Prairie cordgrass	FACW	2	5	Native	☐	15	10.25
Symphyotrichum lanceolatum	White panicle aster	NI	3	2	Native	☐	8	5.20
Symphyotrichum ontarionis	Bottomland aster	FAC	3	5	Native	☐	8	2.31
Symphyotrichum praealtum	Willowleaf aster	FACW	2	5	Native	☐	1	0.01
Teucrium canadense	Canada germander	FACW	2	4	Native	☑	4	0.90
Toxicodendron radicans	Eastern poison ivy	FACU	4	2	Native	☐	3	0.90
Ulmus rubra	Slippery elm	FAC	3	5	Native	☐	1	0.05

1 = OBL - obligate; FACW - facultative wet; FAC - facultative; FACU - facultative upland; UPL - upland; NI - no indicator

2 = Ecological Index values correspond to the wetland indicator status for each species

3 = Frequency is the total number of plots in which the species was identified

4 = Average percent cover is calcuated from the coverages estimated during this monitoring effort.

SECTION A-3

WETLAND 68 GROUND PHOTOGRAPHS

Photo 1: View west of Transect 1 in W-68 (September 2012).

Photo 2: View north of Gradsect 1 on Transect 1 in W-68 (September 2012).

Photo 3: View north of Gradsect 2 on Transect 1 in W-68 (September 2012).

Photo 4: View north of Gradsect 3 on Transect 1 in W-68 (September 2012).

Photo 5: View north of Gradsect 4 on Transect 1 in W-68 (September 2012).

Photo 6: View north of Gradsect 5 on Transect 1 in W-68 (September 2012).

Photo 7: View west of Transect 2 in W-68 (September 2012).

Photo 8: View north of Gradsect 1 on Transect 2 in W-68 (September 2012).

Photo 9: View north of Gradsect 2 on Transect 2 in W-68 (September 2012).

Photo 10: View north of Gradsect 3 on Transect 2 in W-68 (September 2012).

Photo 11: View north of Gradsect 4 on Transect 2 in W-68 (September 2012).

Photo 12: View north of Gradsect 5 on Transect 2 in W-68 (September 2012).

Photo 13: View east of Transect 3 in W-68 (September 2012).

Photo 14: View north of Gradsect 1 on Transect 3 in W-68 (September 2012).

Photo 15: View north of Gradsect 2 on Transect 3 in W-68 (September 2012).

SECTION A-4

RAW DATA SHEETS – WETLAND VEGETATION COVER AND WATER DEPTH AT WETLAND 68

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-1-1

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	5	4	4	4
Amorpha fruticosa	4				
Helianthus grosseserratus			2	3	3
Phalaris arundinacea	3	2			
Poa pratensis	3	3	3	2	
Solidago canadensis			3	4	
Spartina pectinata					4
Symphyotrichum ontarionis		3			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-1-2

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	4	4	5	5	5
Ambrosia artemisiifolia	3				
Amorpha fruticosa			3		2
Helianthus grosseserratus	3	3	4	3	
Poa pratensis	3	4	3		
Solidago canadensis		4	4	3	
Solidago gigantea					2
Spartina pectinata	4				

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-1-3

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	4	4	4	5	6
Amorpha fruticosa				3	3
Helianthus grosseserratus			3		
Physalis longifolia	2				
Poa pratensis	3	3	5		
Schoenoplectus pungens	2				
Solidago canadensis	4	2	3		
Solidago gigantea	2		2		
Spartina pectinata				3	
Symphyotrichum ontarionis		4			1
Symphyotrichum praealtum					1

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-1-4

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	4	4	4	5	5
Amorpha fruticosa	3		3		
Carex sp. 1				3	
Helianthus grosseserratus			2	2	
Poa pratensis	3	3	3	3	2
Schoenoplectus pungens	2				
Solidago canadensis		3	2	3	
Solidago gigantea	4			3	
Spartina pectinata		2			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-1-5

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	5	6	5	5
Amorpha fruticosa		4	3	4	
Helianthus grosseserratus	2				
Poa pratensis	2	2	2		
Schoenoplectus pungens					2
Solidago canadensis			2		2
Spartina pectinata	3				

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-2-1

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	5	6	5	6
Amorpha fruticosa	5		6		
Andropogon gerardii	3				
Boehmeria cylindrica				4	
Calystegia sepium			2		
Carex cristatella				4	
Carex sp. 1	5	4			4
Elymus virginicus		3			
Helianthus grosseserratus	3	4			
Leersia oryzoides					4
Lycopus americanus					3
Medicago lupulina	2	2			
Muhlenbergia schreberi	3				
Poa pratensis	4	4	3		
Polygonum caespitosum				4	3
Schoenoplectus pungens		3	3		3
Solidago canadensis	4	4		2	
Solidago gigantea	4	3	4		
Spartina pectinata	5			4	4
Symphyotrichum lanceolatum				4	6
Symphyotrichum ontarionis	3	3			
Toxicodendron radicans	3			3	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-2-2

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	4	5	5	5
Amorpha fruticosa					5
Boehmeria cylindrica		3		3	
Carex sp. 1	4		3	4	3
Erechtites hieraciifolia	3	4			
Helianthus grosseserratus	2	3			
Leersia oryzoides	3				
Phalaris arundinacea			5	6	5
Phragmites australis			5	3	
Poa pratensis		4			
Salix interior					3
Schoenoplectus pungens		3			
Schoenoplectus tabernaemont			4	4	
Solidago gigantea	2	6			
Spartina pectinata	4	5	5		4
Symphyotrichum lanceolatum		5	3	3	
Toxicodendron radicans		3			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-2-3

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	5	5	5	6
Amorpha fruticosa					2
Boehmeria cylindrica	3				
Carex sp. 1	4	5	5		
Eleocharis erythropoda		4			
Elymus virginicus	3				
Helianthus grosseserratus				2	
Muhlenbergia schreberi					2
Phalaris arundinacea	4	4	6	2	
Poa pratensis				3	
Schoenoplectus pungens	3	3			
Solidago gigantea	2			3	
Spartina pectinata	3				
Symphyotrichum lanceolatum	3				
Symphyotrichum ontarionis				3	
Teucrium canadense				2	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-2-4

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	4	4	6	6	6
Amorpha fruticosa		4	4	3	3
Carex sp. 1	5	6			
Helianthus grosseserratus	3		2		3
Muhlenbergia schreberi				2	
Phalaris arundinacea	4	4			
Phragmites australis					2
Poa pratensis	4				
Schoenoplectus pungens	3		2		
Solidago gigantea		3			
Spartina pectinata		3			
Symphyotrichum lanceolatum		3			
Symphyotrichum ontarionis	3		2		
Teucrium canadense	4	2			
Ulmus rubra					2

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-2-5

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	5
Amorpha fruticosa				3	
Carex sp. 1	3				3
Helianthus grosseserratus			2	3	
Phalaris arundinacea					4
Poa pratensis	3	2			
Polygonum caespitosum					3
Schoenoplectus pungens				2	
Schoenoplectus tabernaemont					3
Solidago canadensis	3				
Solidago gigantea	3				
Spartina pectinata					4

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-3-1

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	7	5	6	6
Amorpha fruticosa				2	3
Poa pratensis			2		
Schoenoplectus tabernaemont					3
Spartina pectinata	2				

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 68

Wetland Name: **W-68**

Wetland Transect/Gradsect #: 68-3-2

Sampling Date: 9/10/2012 **Last Rain Date:** 9/3/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Amorpha fruticosa	4	4	3		3
Carex sp. 1		4	5		
Helianthus grosseserratus		3	3	3	
Muhlenbergia schreberi	3				
Physalis longifolia			2		
Poa pratensis		4			
Solidago canadensis	3	3	3		
Solidago gigantea			3		
Spartina pectinata		4			
Symphyotrichum lanceolatum			3		
Symphyotrichum ontarionis		3			
Teucrium canadense	2				

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

APPENDIX I - SECTION B

PEM WETLAND 25, SAUNDERS COUNTY WELL FIELD WETLAND MONITORING DATA

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SECTION B-1

FIGURES

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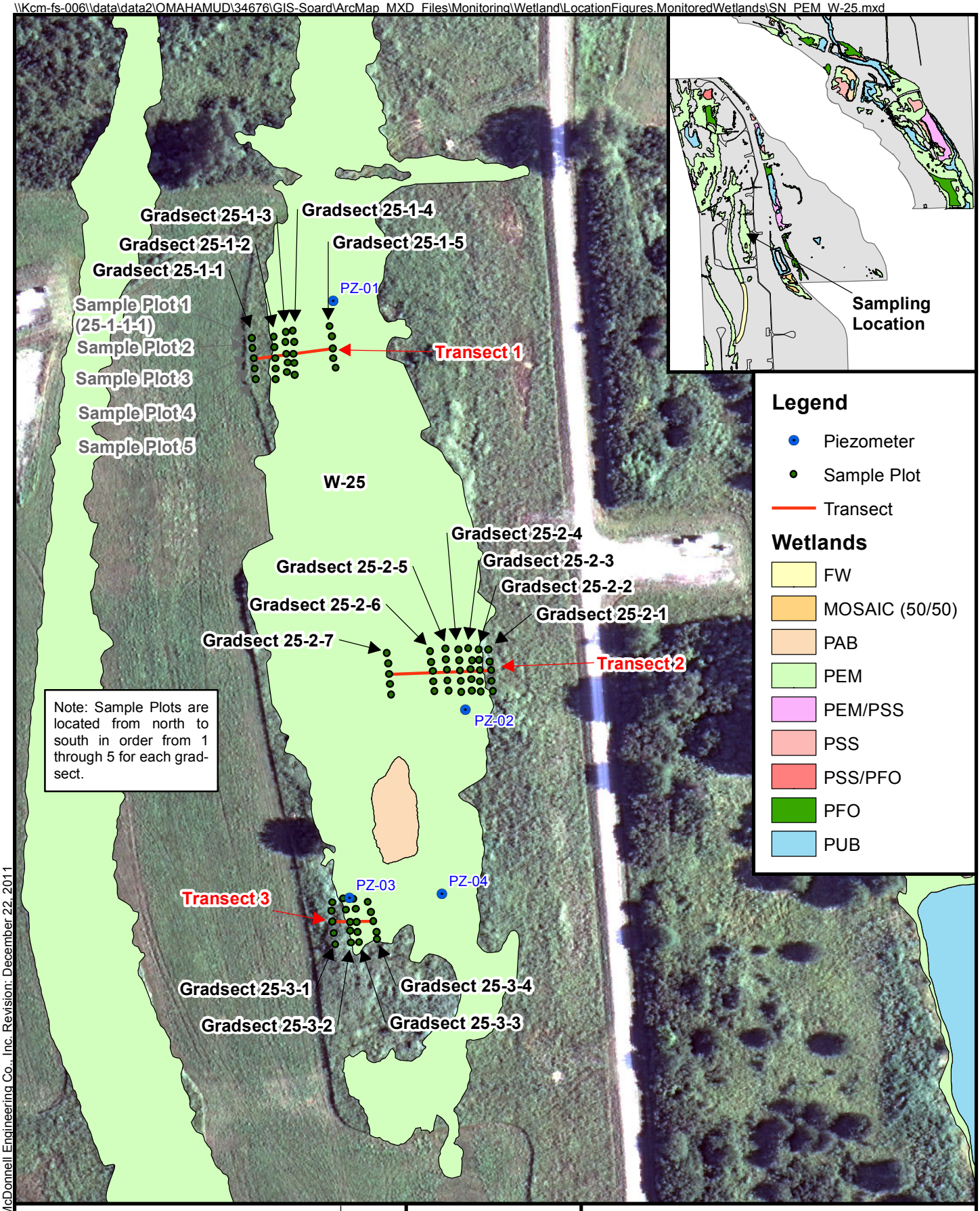

0 50 100 150 200 Feet

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Source: Western Air Maps 2011 Aerial Photography

Burns & McDonnell SINCE 1898

Figure 1
Location Map for
PEM Wetland 25
Saunders County Wellfield
Metropolitan Utilities District

Figure 2 Mean Weighted Average of Wetland Gradsects Compared to the Baseline Threshold in Wetland W-25

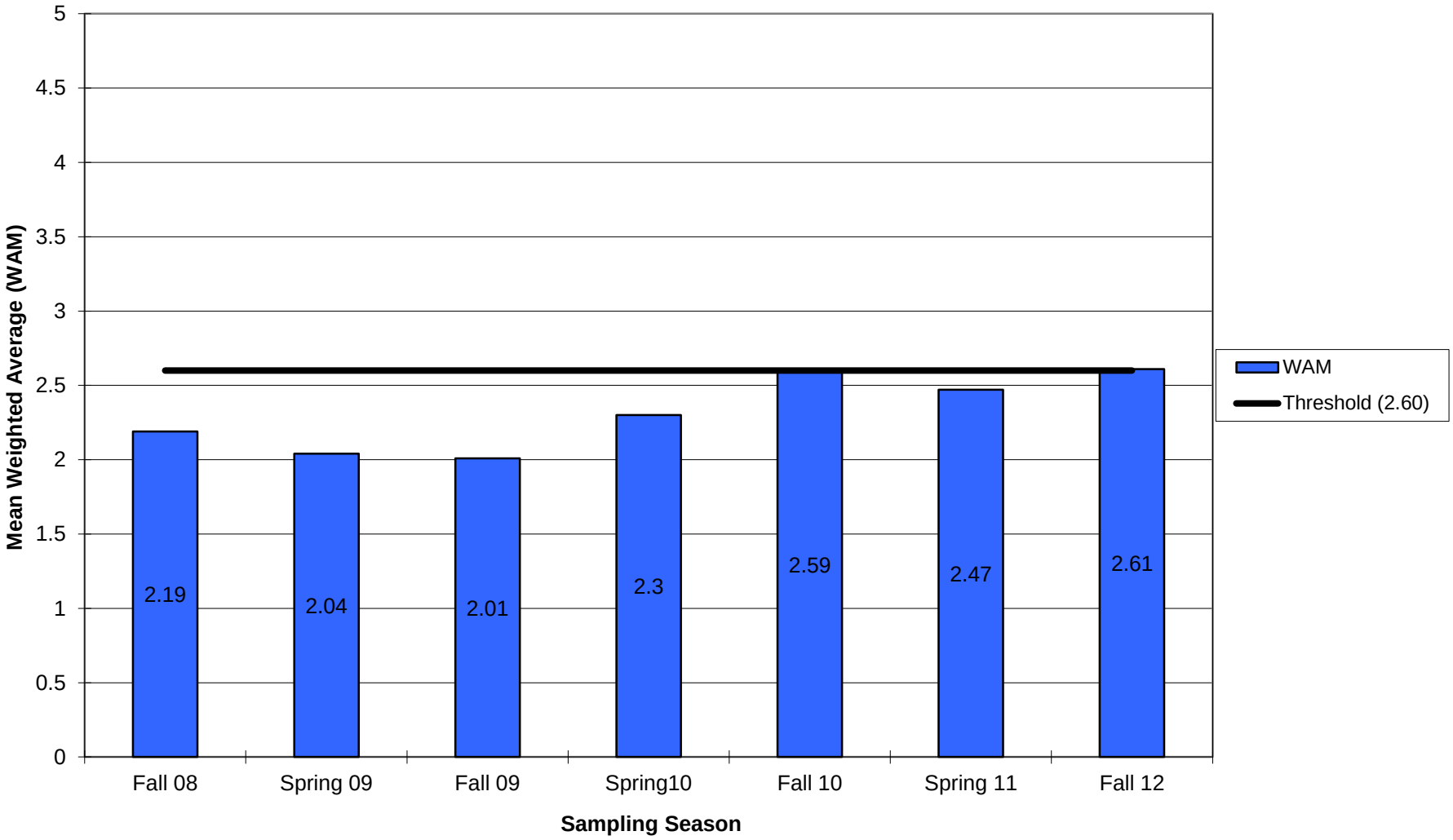
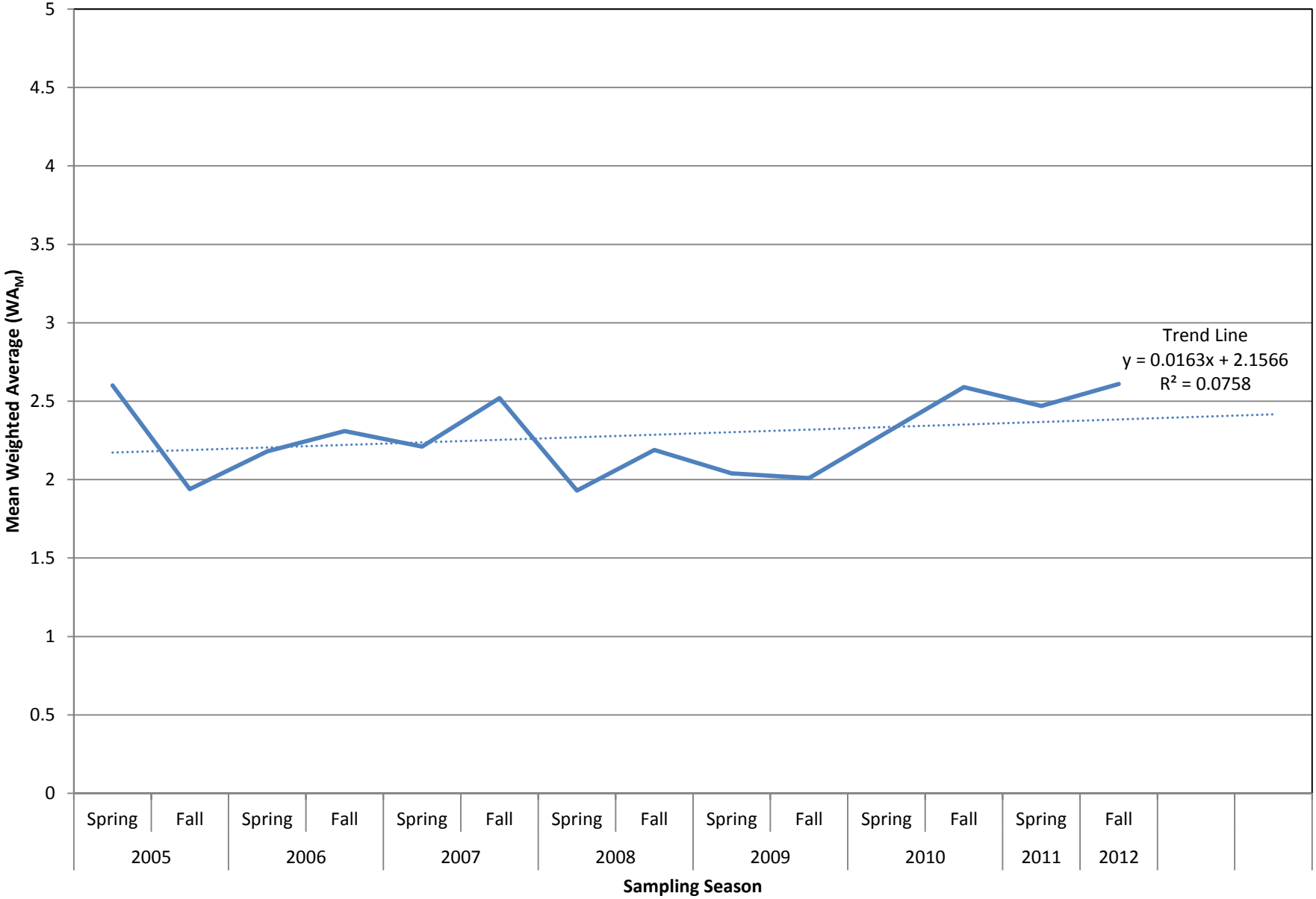


Figure 3 Mean Weighted Average of Wetland 25 Over Time



SECTION B-2

TABLES

Table 1 Summary of Wetland Monitoring Data for Wetland 25

Wetland Name: **W-25**
Wetland Type: **PEM**
County: **Saunders**

Number of Transects/Macroplots: **3**
Number of Gradsects: **16**
Number of Sample Plots: **80**
Number of Wetland Sample Plots: **65**

Sampling Effort: **2012 Fall**

Weighted Average: **2.61**
Species Richness: **26**
Species Diversity: **14.97**
FQI: **10.95**

Percent Native Species: **92**
Percent Invasive Species: **50**
Percent Perennial/Biennial/Annual Species: **69 / 8 / 27**
Mean C-Value: **2.24**

Dominant Species:

Scientific Name	Common Name	Wetland Indicator Status	Percent Cover per Wetland
Carex sp. 1	Sedge	--	20.92
Helianthus grosseserratus	Sawtooth sunflower	FACW	23.23
Phalaris arundinacea	Reed canarygrass	FACW+	21.38
Poa pratensis	Kentucky bluegrass	FACU	12.04

Table 2 Species List and Vegetative Characteristics for Wetland 25

Report generated:
Friday, November 16, 2012

Sampling Effort: **2012 Fall**

Scientific Name	Common Name	Wetland Indicator Status[1]	Ecological Index[2]	C-Value	Native Status	Invasive?	Frequency[3]	Average Percent Cover[4]
Amaranthus retroflexus	Redroot amaranth	FACU	4		Native	☑	4	0.54
Ambrosia artemisiifolia	Annual ragweed	FACU	4	0	Native	☑	14	6.42
Apocynum cannabinum	Indianhemp	FAC	3	2	Native	☑	5	0.74
Asclepias syriaca	Common milkweed	NL	3	1	Native	☑	6	1.73
Cannabis sativa	Marijuana	FACU-	4		Introduced	☑	23	6.65
Carex sp. 1	Sedge	--	3		Native	☐	30	20.92
Carex vulpinoidea	Fox sedge	OBL	1	4	Native	☐	8	6.50
Cirsium altissimum	Tall thistle	NL	3	1	Native	☑	6	1.19
Conyza canadensis	Canadian horseweed	FACU-	4	0	Native	☑	2	0.81
Cornus drummondii	Roughleaf dogwood	FAC	3	3	Native	☐	7	1.77
Desmanthus illinoensis	Illinois bundleflower	FACU	4	5	Native	☐	1	0.01
Helianthus grosseserratus	Sawtooth sunflower	FACW	2	4	Native	☑	29	23.23
Iva annua	Annual marsh elder	FAC	3	1	Native	☐	1	0.23
Phalaris arundinacea	Reed canarygrass	FACW+	2	0	Native	☑	22	21.38
Poa pratensis	Kentucky bluegrass	FACU	4		Native & Introduced	☑	18	12.04
Polygonum amphibium	Water knotweed	OBL	1		Native	☐	15	10.62
Polygonum hydropiperoides	Swamp smartweed	OBL	1		Native	☐	2	0.08
Polygonum pensylvanicum	Pennsylvania smartweed	FACW+	2		Native	☑	2	0.08

1 = OBL - obligate; FACW - facultative wet; FAC - facultative; FACU - facultative upland; UPL - upland; NI - no indicator

2 = Ecological Index values correspond to the wetland indicator status for each species

3 = Frequency is the total number of plots in which the species was identified

4 = Average percent cover is calcuated from the coverages estimated during this monitoring effort.

Table 2 Species List and Vegetative Characteristics for Wetland 25

Report generated:
Friday, November 16, 2012

Polygonum scandens	Climbing false buckwheat	FACU	4		Native & Introduced	☐	1	0.23
Setaria pumila ssp. pumila	Yellow foxtail	FAC	3		Introduced	☑	6	1.73
Solanum carolinense	Carolina horsenettle	UPL	5	2	Native	☑	4	0.54
Solidago canadensis	Canada goldenrod	FACU	4	2	Native	☐	21	11.23
Solidago gigantea	Giant goldenrod	FACW	2	3	Native	☐	15	9.77
Spartina pectinata	Prairie cordgrass	FACW	2	5	Native	☐	11	6.81
Symphyotrichum lanceolatum	White panicle aster	NI	3	2	Native	☐	1	0.23
Vitis riparia	Riverbank grape	FAC	3	3	Native	☐	1	0.23

1 = OBL - obligate; FACW - facultative wet; FAC - facultative; FACU - facultative upland; UPL - upland; NI - no indicator

2 = Ecological Index values correspond to the wetland indicator status for each species

3 = Frequency is the total number of plots in which the species was identified

4 = Average percent cover is calcuated from the coverages estimated during this monitoring effort.

SECTION B-3

WETLAND 25 GROUND PHOTOGRAPHS

Photo 1: View east of Transect 1 in W-25 (September 2012).

Photo 2: View north of Gradsect 1 on Transect 1 in W-25 (September 2012).

Photo 3: View north of Gradsect 2 on Transect 1 in W-25 (September 2012).

Photo 4: View north of Gradsect 3 on Transect 1 in W-25 (September 2012).

Photo 5: View north of Gradsect 4 on Transect 1 in W-25 (September 2012).

Photo 6: View north of Gradsect 5 on Transect 1 in W-25 (September 2012).

Photo 7: View west of Transect 2 in W-25 (September 2012).

Photo 8: View north of Gradsect 1 on Transect 2 in W-25 (September 2012).

Photo 9: View north of Gradsect 3 on Transect 2 in W-25 (September 2012).

Photo 10: View north of Gradsect 4 on Transect 2 in W-25 (September 2012).

Photo 11: View north of Gradsect 5 on Transect 2 in W-25 (September 2012).

Photo 12: View north of Gradsect 6 on Transect 2 in W-25 (September 2012).

Photo 13: View north of Gradsect 7 on Transect 2 in W-25 (September 2012)

Photo 14: View east of Transect 3 in W-25 (September 2012).

Photo 15: View north of Gradsect 1 on Transect 3 in W-25 (September 2012).

Photo 16: View north of Gradsect 2 on Transect 3 in W-25 (September 2012).

Photo 17: View north of Gradsect 3 on Transect 3 in W-25 (September 2012).

Photo 18: View north of Gradsect 4 on Transect 3 in W-25 (September 2012).

SECTION B-4

RAW DATA SHEETS – WETLAND VEGETATION COVER AND WATER DEPTH AT WETLAND 25

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-1-1

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	5	5
Andropogon gerardii	5	6	4	6	5
Desmanthus illinoensis	4	4	3	3	4
Panicum virgatum				4	
Solidago canadensis	3	3	3	3	4
Spartina pectinata	5	4	3	4	4

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-1-2

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Ambrosia artemisiifolia	4		2	4	2
Apocynum cannabinum		3	3		
Carex sp. 1	5	3	4	4	5
Helianthus grosseserratus	5	6	6	6	5
Polygonum pensylvanicum				2	
Solidago canadensis	3	4	4	3	3
Solidago gigantea	5	3			
Symphyotrichum lanceolatum			3		

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-1-3

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Ambrosia artemisiifolia	6	4			
Carex sp. 1	5	6	5	3	5
Cirsium altissimum	2	3			
Helianthus grosseserratus	5	5	5	6	5
Solidago canadensis		3	4		
Solidago gigantea		3			
Vitis riparia					3

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-1-4

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Ambrosia artemisiifolia	5	5	3		
Asclepias syriaca	3				
Carex sp. 1	6	3	3		4
Cirsium altissimum	3				
Conyza canadensis			4		
Helianthus grosseserratus		3	5	5	6
Iva annua			3		
Phalaris arundinacea			3		2
Polygonum hydropiperoides		2		2	
Spartina pectinata		4			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-1-5

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Cannabis sativa			3	3	3
Carex sp. 1	4	5			
Carex vulpinoidea			4	3	4
Cirsium altissimum	3				
Phalaris arundinacea	4	4	4	4	5
Polygonum pensylvanicum		2			
Setaria pumila ssp. pumila	3	3	3		
Spartina pectinata			4	4	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-2-1

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	5	6	6	5
Ambrosia artemisiifolia	3	3	3		
Andropogon gerardii	3	4		4	
Bromus inermis					3
Cornus drummondii			2		3
Desmanthus illinoensis				3	3
Helianthus grosseserratus	3	3	5	5	5
Poa pratensis	4	3	5	4	6
Schizachyrium scoparium	5	4	3		
Solidago canadensis	4	4	4	4	4
Symphyotrichum pilosum	2	3			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-2-3

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	7	7	7	7	7
Amaranthus retroflexus	3				
Ambrosia artemisiifolia				3	
Carex sp. 1	3	4			
Cornus drummondii				3	
Desmanthus illinoensis	1				
Helianthus grosseserratus	5	4	4	4	4
Poa pratensis		2	3	2	3
Setaria pumila ssp. pumila	3				
Solidago canadensis	4	4	5	5	5
Solidago gigantea				3	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-2-4

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	5	5	6	6
Ambrosia artemisiifolia	3	3			3
Carex sp. 1	4	5	3	4	
Cornus drummondii		3	3	4	
Helianthus grosseserratus	2	3		2	4
Poa pratensis	6	6	6	3	4
Setaria pumila ssp. pumila				3	
Solidago canadensis	5	4	4	4	3
Solidago gigantea			4	5	4

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-2-5

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	4	5	5	6	6
Ambrosia artemisiifolia				3	
Apocynum cannabinum	3				
Cannabis sativa	3	3	3	2	2
Carex sp. 1	6	5	4	4	5
Cornus drummondii			3		2
Poa pratensis	5	5	5	4	
Setaria pumila ssp. pumila					4
Solidago canadensis	4		4		3
Solidago gigantea			4	5	5
Spartina pectinata					3

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-2-6

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Cannabis sativa		2	4	3	4
Carex sp. 1		4	5		
Carex vulpinoidea	5				
Cirsium altissimum					3
Cornus drummondii					3
Poa pratensis	5	5	4	4	3
Solidago canadensis		3			
Solidago gigantea				6	5
Spartina pectinata	3	5	5		6

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-2-7

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	7	6	6	6	6
Amaranthus retroflexus		3	2	2	
Apocynum cannabinum		1		2	
Cannabis sativa	3	4	3	5	4
Carex vulpinoidea		5	4	6	6
Cirsium altissimum		3			
Conyza canadensis	3				
Helianthus grosseserratus			6	3	
Solanum carolinense		2	2	3	
Spartina pectinata	4				4

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-3-1

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Asclepias syriaca				3	
Boehmeria cylindrica				4	
Cannabis sativa	4	3	3	3	4
Elymus virginicus			2		
Helianthus grosseserratus		3	5	4	5
Phalaris arundinacea	3	3	3		
Polygonum amphibium	6	5	4	3	3
Polygonum scandens		3			
Solidago canadensis			4		
Solidago gigantea		3	3		
Spartina pectinata	4	5			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-3-2

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	6	7	6	6
Asclepias syriaca		3	3		
Cannabis sativa		3	3		2
Helianthus grosseserratus			5	4	4
Phalaris arundinacea	6	6	3	5	6
Polygonum amphibium	5	5	4	4	4
Polygonum scandens		3			
Solidago gigantea			3		

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-3-3

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	5	6	6	6	6
Asclepias syriaca				3	
Cannabis sativa			3		3
Carex sp. 1				3	
Helianthus grosseserratus				5	
Phalaris arundinacea	6	6	6	6	6
Polygonum amphibium	4	5	4	5	4
Solidago gigantea					5

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 25

Wetland Name: **W-25**

Wetland Transect/Gradsect #: 25-3-4

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	5	5	6
Asclepias syriaca				3	4
Phalaris arundinacea	6	6	6	6	5
Polygonum amphibium	3	4	5	5	4
Solanum carolinense	3				
Solidago gigantea					2
Spartina pectinata					3

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

APPENDIX I - SECTION C

PEM WETLAND 100, SAUNDERS COUNTY WELL FIELD WETLAND MONITORING DATA

TABLE OF CONTENTS

SECTION C-1

FIGURES

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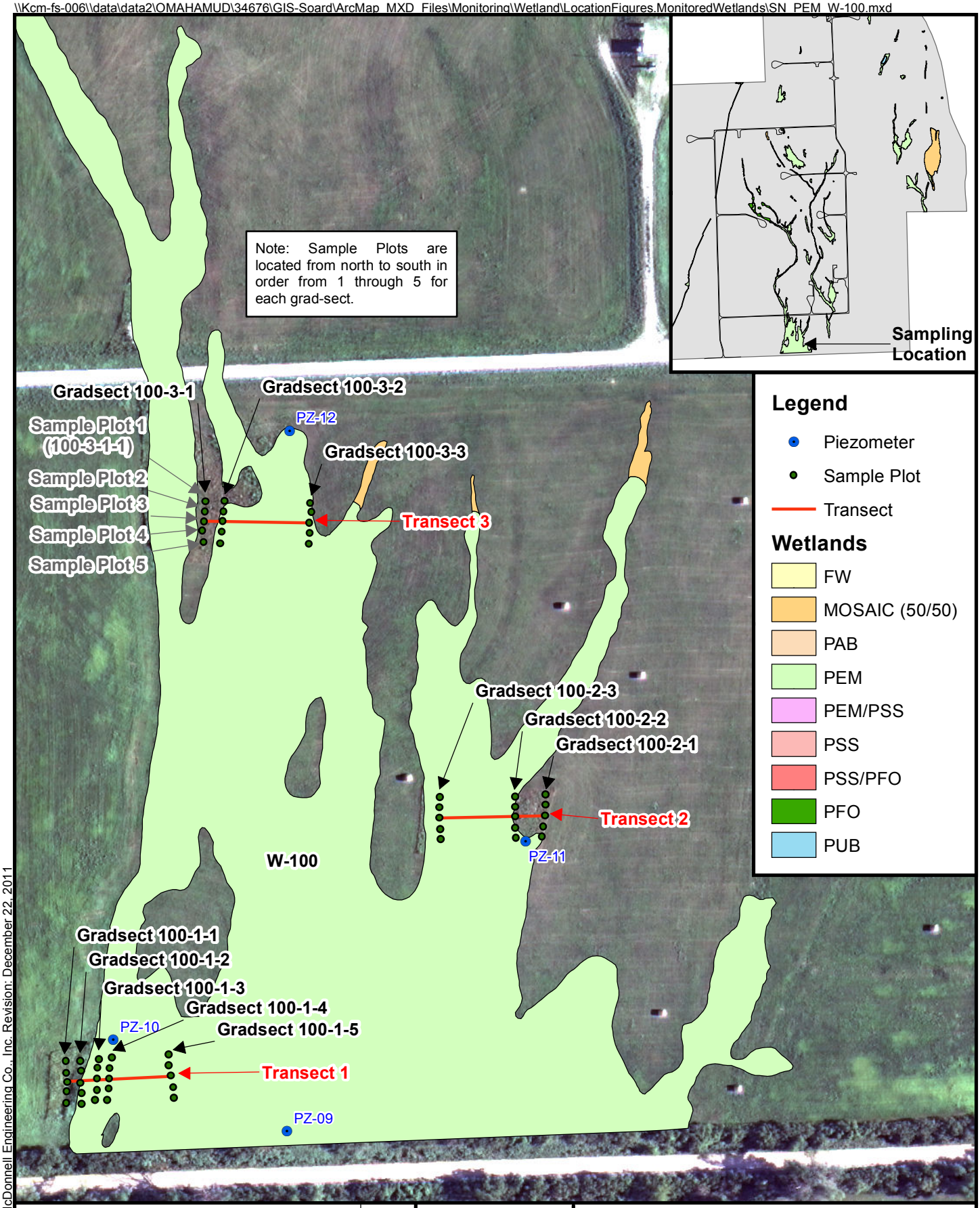


Source: Western Air Maps 2011 Aerial Photography

Figure 1
Location Map for
PEM Wetland 100
Saunders County Wellfield
Metropolitan Utilities District

Figure 2 Mean Weighted Average of Wetland Gradsects Compared to the Baseline Threshold in Wetland-100

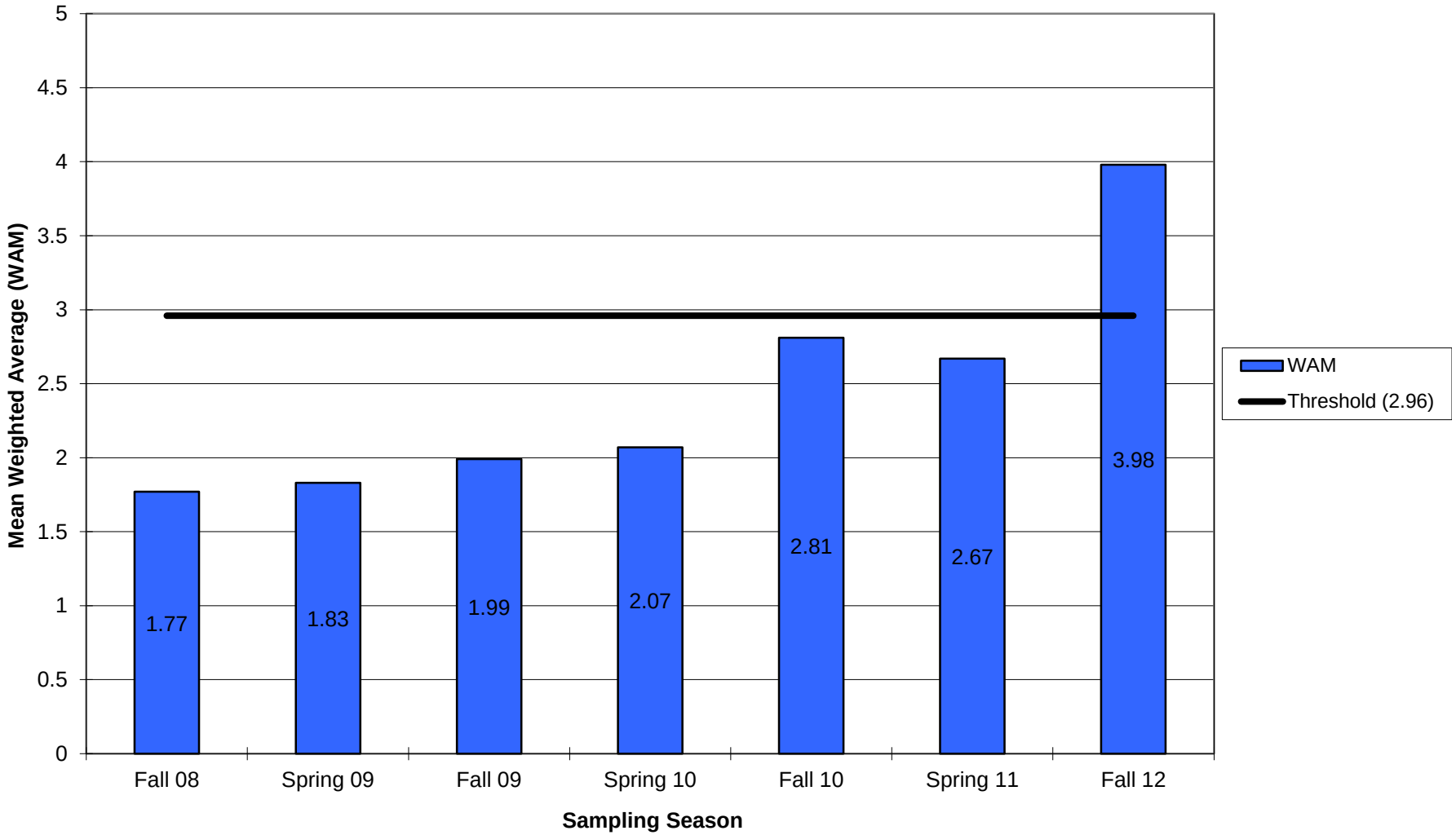
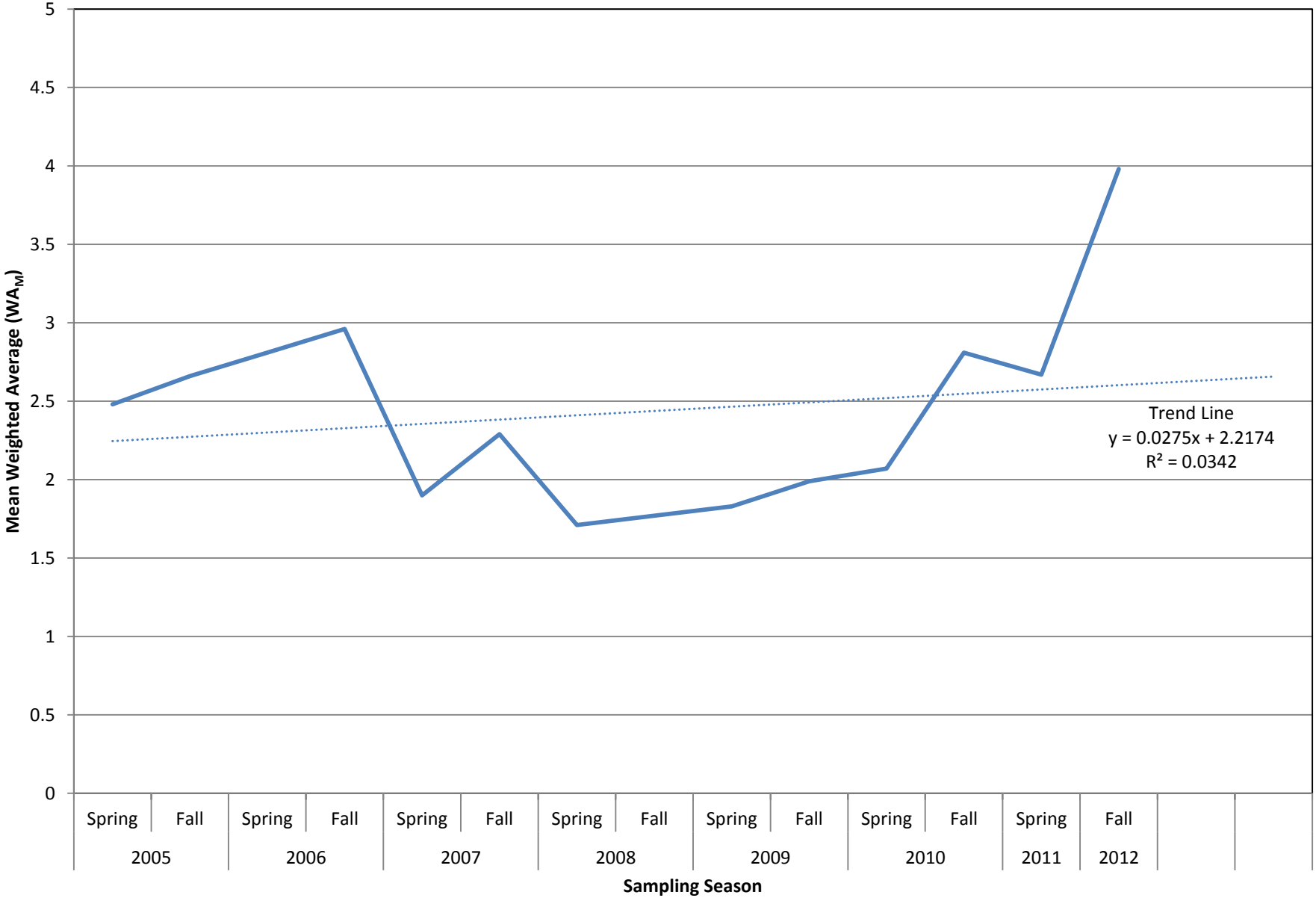


Figure 3 Mean Weighted Average of Wetland 100 Over Time



SECTION C-2

TABLES

Table 1 Summary of Wetland Monitoring Data for Wetland 100

Wetland Name: **W-100**
Wetland Type: **PEM**
County: **Saunders**

Number of Transects/Macroplots: **3**
Number of Gradsects: **11**
Number of Sample Plots: **55**
Number of Wetland Sample Plots: **40**

Sampling Effort: **2012 Fall**

Weighted Average: **3.98**
Species Richness: **5**
Species Diversity: **2.36**
FQI: **2.00**

Percent Native Species: **80**
Percent Invasive Species: **80**
Percent Perennial/Biennial/Annual Species: **20 / 20 / 80**
Mean C-Value: **1.00**

Dominant Species:

Scientific Name	Common Name	Wetland Indicator Status	Percent Cover per Wetland
Amaranthus retroflexus	Redroot amaranth	FACU	0.38
Ambrosia artemisiifolia	Annual ragweed	FACU	2.06
Conyza canadensis	Canadian horseweed	FACU-	0.38

Table 2 Species List and Vegetative Characteristics for Wetland 100

Report generated:
Friday, November 16, 2012

Sampling Effort: **2012 Fall**

Scientific Name	Common Name	Wetland Indicator Status[1]	Ecological Index[2]	C-Value	Native Status	Invasive?	Frequency[3]	Average Percent Cover[4]
Amaranthus retroflexus	Redroot amaranth	FACU	4		Native	☑	1	0.38
Ambrosia artemisiifolia	Annual ragweed	FACU	4	0	Native	☑	8	2.06
Cannabis sativa	Marijuana	FACU-	4		Introduced	☑	1	0.06
Conyza canadensis	Canadian horseweed	FACU-	4	0	Native	☑	1	0.38
Ulmus americana	American elm	FAC	3	3	Native	☐	1	0.06

1 = OBL - obligate; FACW - facultative wet; FAC - facultative; FACU - facultative upland; UPL - upland; NI - no indicator

2 = Ecological Index values correspond to the wetland indicator status for each species

3 = Frequency is the total number of plots in which the species was identified

4 = Average percent cover is calcuated from the coverages estimated during this monitoring effort.

SECTION C-3

WETLAND 100 GROUND PHOTOGRAPHS

Photo 1: View east of Transect 1 in W-100 (September 2012).

Photo 2: View north of Gradsect 1 on Transect 1 in W-100 (September 2012).

Photo 3: View north of Gradsect 2 on Transect 1 in W-100 (September 2012).

Photo 4: View north of Gradsect 3 on Transect 1 in W-100 (September 2012).

Photo 5: View north of Gradsect 4 on Transect 1 in W-100 (September 2012).

Photo 6: View north of Gradsect 5 on Transect 1 in W-100 (September 2012).

Photo 7: View west of Transect 2 in W-100 (September 2012).

Photo 8: View north of Gradsect 1 on Transect 2 in W-100 (September 2012).

Photo 9: View north of Gradsect 2 on Transect 2 in W-100 (September 2012).

Photo 10: View north of Gradsect 3 on Transect 2 in W-100 (September 2012).

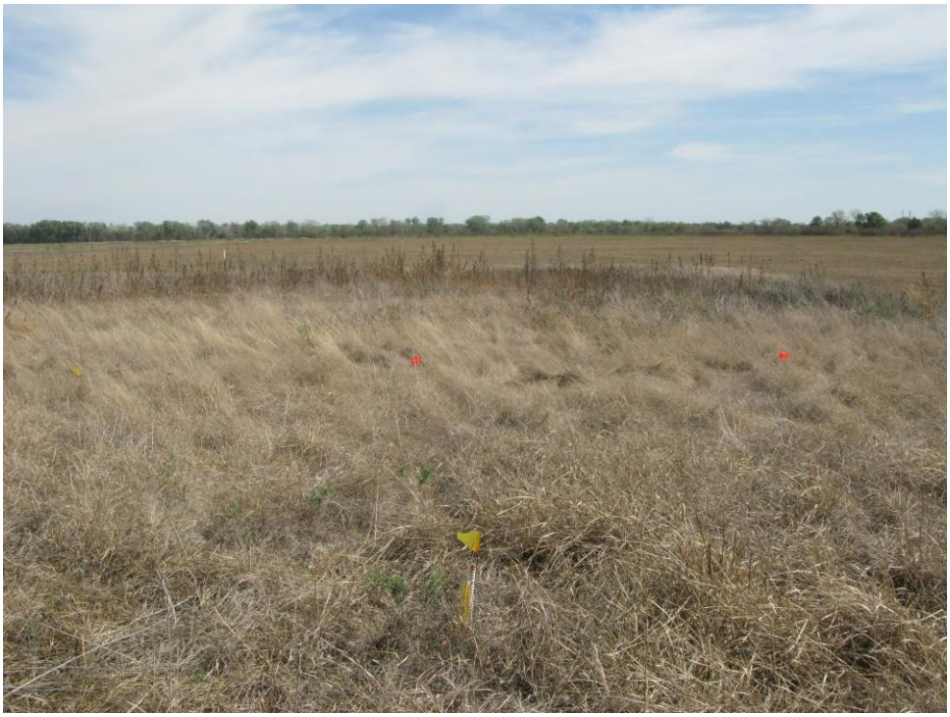


Photo 11: View east of Transect 3 in W-100 (September 2012).

Photo 12: View north of Gradsect 1 on Transect 3 in W-100 (September 2012).

Photo 13: View north of Gradsect 2 on Transect 3 in W-100 (September 2012).

Photo 14: View north of Gradsect 3 on Transect 3 in W-100 (September 2012).

SECTION C-4

RAW DATA SHEETS – WETLAND VEGETATION COVER AND WATER DEPTH AT WETLAND 100

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-1-1

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Schedonorus phoenix	3				
Solidago canadensis	3	2			

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-1-2

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	7	7	7	7

No Living Vegetation

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-1-3

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	7	7	7	7	7

No Living Vegetation

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-1-4

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6

No Living Vegetation

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-1-5

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	7	6	6	7	6

No Living Vegetation

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-2-1

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	7	6	6	6
Ambrosia artemisiifolia	3	3		3	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-2-2

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Ambrosia artemisiifolia		3		3	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-2-3

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Amaranthus retroflexus			3		
Ambrosia artemisiifolia		3	2	3	
Conyza canadensis	3				

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-3-1

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	7	6	6	6	6
Ambrosia artemisiifolia			3		

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-3-2

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	6	6
Cannabis sativa	2				
Ulmus americana	2				

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

Wetland Vegetation Cover and Water Depth at Wetland 100

Wetland Name: **W-100**

Wetland Transect/Gradsect #: 100-3-3

Sampling Date: 9/11/2012 **Last Rain Date:** 9/10/2012 **Last Rain Amount (in):** 0.01

Canopy Coverage Analysis	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Depth of Standing Water (in):					
Open Water (in):					
Bare Soil (in):	6	6	6	7	6
Ambrosia artemisiifolia	3		2	2	

Class 1: 0-1%; Class 2: 1-5%; Class 3: 5-25%; Class 4: 25-50%; Class 5: 50-75%; Class 6: 75-95%; Class 7: 95-100%

APPENDIX II

COMPREHENSIVE VEGETATION SPECIES LIST BY WETLAND, 2005-2012

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Wetland Indicator Status	C Value	PEM			PFO			PSS
					W-68	W-100	W-25	W-5	W-51	W-54	W-55
Acalypha rhomboidea	Common threeseed mercury	Native	FACU-	0		X			X	X	X
Acer negundo	Boxelder	Native	FAC	1	X						
Acer rubrum	Red maple	Native	--		X						
Acer saccharinum	Silver maple	Native	FACW	4						X	
Achillea millefolium	Common yarrow	Native & Introduced	FACU	2		X					
Ageratina altissima	White snakeroot	Native	NI	4					X		
Agrimonia gryposepala	Tall hairy agrimony	Native	FAC	5					X		
Agrostis gigantea	Redtop	Introduced	NI	0	X	X	X	X	X		
Agrostis sp.	Bentgrass	--	--					X			
Agrostis stolonifera	Creeping bentgrass	Introduced	FAC+		X		X	X	X		
Amaranthus retroflexus	Redroot amaranth	Native	FACU			X	X				
Amaranthus tuberculatus	Roughfruit amaranth	Native	OBL	0		X					
Ambrosia artemisiifolia	Annual ragweed	Native	FACU	0	X	X	X	X	X		X
Ambrosia psilostachya	Cuman ragweed	Native	FAC	1		X					
Ambrosia trifida	Great ragweed	Native	FACW	0		X			X		
Amorpha fruticosa	Desert false indigo	Native	OBL	5	X				X		
Amphicarpaea bracteata	American hogpeanut	Native	FACW	4					X		
Andropogon gerardii	Big bluestem	Native	FAC-	5	X	X	X				
Anemone canadensis	Canadian anemone	Native	FACW	4	X				X		
Anemone caroliniana	Carolina anemone	Native	NL	7	X						
Anemone virginiana	tall thimbleweed	Native	NI	4			X				
Apios americana	Groundnut	Native	FACW	6	X				X		X
Apocynum cannabinum	Indianhemp	Native	FAC	2	X		X				
Arnoglossum plantagineum	Groovestem Indian plantain	Native	FACW	7			X				
Asarum canadense	Canadian wildginger	Native	NL	0				X			
Asclepias incarnata	Swamp milkweed	Native	OBL	4	X	X	X				
Asclepias sp.	Milkweed	Native	--		X		X				
Asclepias syriaca	Common milkweed	Native	NL	1	X		X				
Astragalus lotiflorus	Lotus milkvetch	Native	NL	4	X						
Avena sativa	Common oat	Introduced	NL		X		X				
Bidens cernua	Nodding beggartick	Native	OBL	3			X				
Bidens sp.	Beggartick	Native	FACW				X				
Boehmeria cylindrica	Smallspike false nettle	Native	OBL	6	X	X	X		X	X	X

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Brassica sp.	Mustard	--	--		X						
Bromus arvensis	Field brome	Introduced	NL		X						
Bromus inermis	Smooth brome	Native & Introduced	NL		X	X	X				
Calamagrostis canadensis	Bluejoint	Native	OBL	6	X	X	X		X		
Calamagrostis stricta	Slimstem reedgrass	Native	NL	6	X		X	X	X		
Calystegia sepium	Hedge false bindweed	Native & Introduced	FAC	1	X	X					
Camassia scilloides	Atlantic camas	Native	FAC				X				
Cannabis sativa	Marijuana	Introduced	FACU-			X	X				
Capsella bursa-pastoris	Shepherd's purse	Introduced	FACU			X					
Carduus nutans	Nodding plumless thistle	Introduced	NL		X						
Carex aquatilis	Water sedge	Native	OBL	9		X					
Carex bicknellii	Bicknell's sedge	Native	FACU	6	X						X
Carex blanda	Eastern woodland sedge	Native	FAC	2					X		
Carex brevior	Shortbeak sedge	Native	FAC	4	X	X		X	X	X	X
Carex cristatella	Crested sedge	Native	FACW	5	X						
Carex emoryi	Emory's sedge	Native	OBL	5		X					
Carex grayi	Gray's sedge	Native	FACW	0			X				
Carex molesta	Troublesome sedge	Native	FAC	3	X	X					
Carex pellita	Wooly sedge	Native	OBL	4	X	X	X	X			
Carex praegracilis	Clustered field sedge	Native	FACW	4	X	X	X	X			
Carex sartwellii	Sartwell's sedge	Native	OBL	6				X			
Carex sp. 1	Sedge	Native	--		X	X	X	X	X	X	X
Carex sp. 2	Sedge	Native	--		X	X	X	X	X		
Carex sp. 3	Sedge	Native	--				X				
Carex stricta	Upright sedge	Native	OBL				X				
Carex vulpinoidea	Fox sedge	Native	OBL	4		X	X	X	X	X	X
Celtis occidentalis	Commom hackberry	Native	FACU	4					X	X	X
Chamaecrista fasciculata	Partridge pea	Native	NL	1	X						
Chenopodium album	Lambsquarters	Native & Introduced	FAC			X	X				
Cicuta maculata	Spotted waterhemlock	Native	OBL	5	X						
Cinna arundinacea	Sweet woodreed	Native	FACW	5					X		
Cirsium altissimum	Tall thistle	Native	NL	1	X	X	X	X	X		
Cirsium arvense	Canada thistle	Introduced	FACU				X				
Cirsium canescens	Prairie thistle	Native	NL	4			X				
Cirsium sp.	Thistle	--	--			X					

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Commelina erecta	Whitemouth dayflower	Native	NL	5					X		
Convolvulus arvensis	Field bindweed	Introduced	NL		X	X			X		
Conyza canadensis	Canadian horseweed	Native	FACU-	0	X	X	X				
Cornus drummondii	Roughleaf dogwood	Native	FAC	3	X		X	X	X	X	X
Cryptotaenia canadensis	Canada honewort	Native	FACU	4				X	X		
Cynodon dactylon	Bermudagrass	Introduced	FACU		X		X				
Cyperus acuminatus	Tapertip flatsedge	Native	OBL	3	X						
Cyperus esculentus	Yellow nutsedge	Native & Introduced	FACW	0	X	X	X				
Cyperus strigosus	Strawcolored flatsedge	Native	FACW	4	X		X				
Desmanthus illinoensis	Illinois bundleflower	Native	FACU	5	X		X	X			
Dichanthelium acuminatum	Tapered rosette grass	Native	FAC	6	X		X				
Dichanthelium oligosanthes	Heller's rosette grass	Native	FACU	4	X		X				
Digitaria ischaemum	Smooth crabgrass	Introduced	UPL		X						
Distichlis spicata	Saltgrass	Native	FACW	3	X				X		
Doellingeria umbellata	parasol whitetop	Native	FACW	2		X					
Echinochloa crus-galli	Barnyardgrass	Introduced	FACW			X	X				
Echinochloa sp.	Barnyardgrass	--	--				X				
Eleocharis compressa	Flatstem spikerush	Native	FACW	6			X				
Eleocharis erythropoda	Bald spikerush	Native	OBL	5	X	X	X	X			
Eleocharis lanceolata	Daggerleaf spikerush	Native	FACW+		X		X				
Eleocharis obtusa	Blunt spikerush	Native	OBL	3	X						
Eleocharis palustris	Common spikerush	Native	OBL	4		X					
Eleocharis sp.	Spikerush	--	--		X	X	X	X			
Elymus canadensis	Canada wildrye	Native	FACU	5	X	X	X				
Elymus hystrix	Eastern bottlebrush grass	Native	NL	6	X	X		X			
Elymus submuticus	Virginia wildrye	Native	NL		X				X		X
Elymus virginicus	Virginia wildrye	Native	FAC	4	X		X		X	X	X
Equisetum arvense	Field horsetail	Native	FAC	4	X		X	X	X		X
Equisetum hyemale	Scouringrush horsetail	Native	FACW	4			X				
Erechtites hieraciifolia	American burnweed	Native	FAC	1	X		X		X	X	
Erigeron annuus	Eastern daisy fleabane	Native	FACU	1		X					
Erigeron strigosus	Prairie fleabane	Native	FAC	2	X		X				
Eupatoriadelphus maculatus	Spotted trumpetweed	Native	OBL			X					
Eupatorium perfoliatum	Common boneset	Native	OBL	5	X				X		
Eupatorium purpureum	Sweet scented joe pye weed	Native	NL				X		X		

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Eupatorium serotinum	Lateflowering thoroughwort	Native	FAC	3				X			
Eupatorium sp.	Thoroughwort	Native	--		X						
Euthamia gymnospermoides	Texas goldentop	Native	FACW	4	X						
Fragaria virginiana	Virginia strawberry	Native	FACU	5					X		
Fraxinus pennsylvanica	Green ash	Native	FACW	2				X	X	X	X
Galium aparine	Stickywilly	Native	FACU	0	X	X	X	X	X	X	X
Galium obtusum	Bluntleaf bedstraw	Native	FACW	6	X	X	X	X	X		X
Galium pilosum	Hairy bedstraw	Native	NL						X		
Galium trifidum	Threepetal bedstraw	Native	OBL	8					X		
Galium triflorum	Fragrant bedstraw	Native	FACU	4	X				X		
Gaura longiflora	Longflower beeblossom	Native	NL	3			X				
Geum canadense	White avens	Native	FACU	3	X		X	X	X	X	X
Gleditsia triacanthos	Honeylocust	Native	FAC	1	X				X		
Helenium autumnale	Common sneezeweed	Native	FACW	6	X		X				
Helianthus annuus	Common sunflower	Native	FACU	0	X		X				
Helianthus grosseserratus	Sawtooth sunflower	Native	FACW	4	X	X	X	X	X		
Helianthus maximiliani	Maxilian sunflower	Native	UPL	4	X		X		X		
Helianthus pauciflorus	Stiff sunflower	Native	NL	5	X			X	X		
Helianthus sp.	Sunflower	Native	--		X		X		X		
Hieracium longipilum	Hairy hawkweed	Native	NL	6			X				
Hordeum jubatum	Foxtail barley	Native	FACW	1	X	X	X	X			
Hypericum sp.	St. Johnswort	--	--		X						
Impatiens capensis	Jewelweed	Native	FACW	4	X						
Impatiens sp.	Touch-me-not	--	--		X						
Ipomoea hederacea	Ivyleaf morning-glory	Introduced	FACU		X						
Ipomoea purpurea	Tall morning-glory	Introduced	FACU		X	X	X				
Iris virginica	Virginia iris	Native	OBL	8							X
Iva annua	Annual marsh elder	Native	FAC	1		X	X	X			
Juglans nigra	Black walnut	Native	FACU	5					X		
Juncus arcticus ssp. Littoralis	Mountain rush	Native	OBL	6			X				
Juncus dudleyi	Dudley's rush	Native	NL	5	X		X				
Juncus effusus	Common rush	Native	OBL	6	X		X				
Juncus interior	Inland rush	Native	FAC	4	X						
Juncus sp.	Rush	Native	--		X	X					
Juncus tenuis	Poverty rush	Native	FAC	3	X		X	X	X		

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Juncus torreyi	Torrey's rush	Native	FACW	4	X		X				
Lactuca ludoviciana	Biannual lettuce	Native	FAC	3			X				
Lactuca serriola	Prickly lettuce	Introduced	FAC		X	X	X				
Lactuca sp.	Lettuce	--	--			X		X			
Laportea canadensis	Canadian woodnettle	Native	FACW	4	X				X		X
Leersia oryzoides	Rice cutgrass	Native	OBL	4	X	X	X		X		X
Leersia virginica	White grass	Native	FACW	4	X	X		X	X		
Lepidium virginicum	Virginia pepperweed	Native	FACU	0		X					
Leptochloa fusca	Bearded sprangletop	Native	OBL	1		X					
Liatris punctata	Dotted blazing star	Native	NL	5			X				
Lonicera japonica	Japanese honeysuckle	Introduced	FACU						X		
Lycopus americanus	American water horehound	Native	OBL	4	X	X	X	X			
Lycopus asper	Rough bugleweed	Native	OBL	5	X		X				
Lycopus uniflorus	Northern bugleweed	Native	OBL	6		X	X		X		X
Lycopus virginicus	Virginia water horehound	Native	OBL	5	X	X	X			X	X
Lysimachia nummularia	Creeping jenny	Introduced	OBL								X
Lysimachia thyrsiflora	Tufted loosestrife	Native	OBL	7	X				X		
Lythrum alatum	Winged lythrum	Native	OBL	6		X					
Medicago lupulina	Black medick	Introduced	FAC		X		X				
Medicago sp.	Medick	Introduced	--				X				
Melilotus officinalis	Yellow sweetclover	Introduced	FACU		X						
Melilotus sp.	Clover	--	--		X						
Mentha arvensis	Wild mint	Native	FACW	4	X	X	X	X	X		
Morus alba	White mulberry	Introduced	FAC							X	
Morus sp.	Mulberry	--	--					X		X	
Muhlenbergia asperifolia	Scratchgrass	Native	FACW	5	X	X		X	X		
Muhlenbergia cuspidata	Plains muhly	Native	NL	5	X						
Muhlenbergia mexicana	Mexican muhly	Native	FACW	4	X						
Muhlenbergia racemosa	Marsh muhly	Native	FACW	4	X				X		
Muhlenbergia schreberi	Nimblewill	Native	FACU	0	X				X		
Muhlenbergia sp.	Muhly	Native	--		X				X		
Oxalis stricta	Common yellow oxalis	Native	FACU	0	X						
Panicum capillare	Witchgrass	Native	FAC	0			X				
Panicum virgatum	Switchgrass	Native	FAC	4	X		X				
Parietaria pensylvanica	Pennsylvania pellitory	Native	FAC	0		X	X	X			

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Parthenocissus quinquefolia	Virginia creeper	Native	FAC	5					X	X	X
Pascopyrum smithii	Western wheatgrass	Native	NL		X		X				X
Paspalum dilatatum	Dallisgrass	Introduced	NI						X		
Phalaris arundinacea	Reed canarygrass	Native	FACW+	0	X	X	X	X	X	X	X
Phragmites australis	Common reed	Native	FACW		X						
Phyla lanceolata	Lanceleaf fogfruit	Native	OBL	3	X	X	X	X		X	X
Physalis heterophylla	Clammy groundcherry	Native	NL	4		X	X				
Physalis longifolia	Longleaf groundcherry	Native	NL	0	X	X	X				
Physalis virginiana	Virginia groundcherry	Native	NL	6				X			
Physostegia virginiana	Obedient plant	Native	OBL	7		X		X			
Pilea pumila	Canadian clearweed	Native	FAC	4			X				
Plantago patagonica	Woolly plantain	Native	UPL	1	X						
Poa pratensis	Kentucky bluegrass	Native & Introduced	FACU		X	X	X	X	X		
Podophyllum peltatum	Mayapple	Native	FACU-	7	X				X		
Polygonatum biflorum	Smooth Solomon's seal	Native	UPL	4			X		X		
Polygonum amphibium	Water knotweed	Native	OBL				X				X
Polygonum aviculare	Prostrate knotweed	Introduced	FACW		X						
Polygonum caespitosum	Oriental lady's thumb	Introduced	NI			X	X		X		
Polygonum hydropiper	Marshpepper knotweed	Introduced	OBL				X				
Polygonum hydropiperoides	Swamp smartweed	Native	OBL		X	X	X		X		X
Polygonum pensylvanicum	Pennsylvania smartweed	Native	FACW+		X	X	X				X
Polygonum punctatum	Dotted smartweed	Native	OBL		X	X	X				
Polygonum scandens	Climbing false buckwheat	Native & Introduced	FACU		X	X	X				
Polygonum sp.	Polygonum	--	--		X	X	X	X	X	X	
Populus deltoides	Eastern cottonwood	Native	FAC	3					X	X	
Potamogeton amplifolius	Largeleaf pondweed	Native	OBL	10	X		X				
Potentilla arguta	Tall cinquefoil	Native	FACU						X		
Prunella vulgaris	Common selfheal	Native	FAC	4					X		
Prunus sp.	Plum	Native	--					X			
Pycnanthemum tenuifolium	Narrowleaf mountainmint	Native	FACW	7			X				
Pycnanthemum virginianum	Virginia mountainmint	Native	FAC	6			X	X			
Ranunculus sceleratus	Cursed buttercup	Native	OBL		X						
Rudbeckia hirta	Blackeyed susan	Native	FACU	4	X		X				
Rudbeckia laciniata	Cutleaf coneflower	Native	FAC	4					X		
Rumex crispus	Curly dock	Introduced	FACW			X	X				X

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Rumex orbiculatus	Greater water dock	Native	OBL		X						
Rumex sp.	Dock	--	--		X	X					
Sagittaria latifolia	Broadleaf arrowhead	Native	OBL	5		X					
Salix amygdaloides	Peachleaf willow	Native	FACW	4	X				X	X	
Salix exigua	Narrowleaf willow	Native	OBL	3	X						X
Salix interior	Sandbar willow	Native	NL	3	X						X
Salix lutea	Yellow willow	Native	OBL	6	X						
Salix nigra	Black willow	Native	OBL	3					X	X	X
Sambucus canadensis	Common elderberry	Native	FAC	2						X	
Sanicula canadensis	Canadian blacksnakeroot	Native	NI	3					X	X	
Sanicula odorata	Clustered blacksnakeroot	Native	FAC	4				X	X	X	X
Saxifraga sp.	Saxifrage	Native	--					X			
Schedonorus phoenix	Tall fescue	Introduced	FACU		X	X	X	X	X		
Schizachyrium scoparium	Little bluestem	Native	FACU	4			X				
Schoenoplectus acutus var. acutus	Hardstem bulrush	Native	OBL	5		X	X				
Schoenoplectus fluviatilis	River bulrush	Native	OBL		X		X	X			X
Schoenoplectus pungens	Common threesquare	Native	OBL	4	X	X	X	X			X
Schoenoplectus tabernaemontani	Softstem bulrush	Native	OBL	5			X				
Scirpus sp.	Bulrush	Native	OBL		X						X
Setaria faberi	Japanese bristlegrass	Introduced	UPL				X				
Setaria pumila ssp. pumila	Yellow foxtail	Introduced	FAC			X	X				
Setaria verticillata	Hooked bristlegrass	Introduced	FAC				X				
Setaria viridis	Green bristlegrass	Introduced	NL				X				
Sium suave	Hemlock waterparsnip	Native	OBL	7	X						
Smilax bona-nox	Saw greenbrier	Native	FAC		X						
Smilax sp.	Greenbrier	Native	--						X		
Smilax tamnoides	Bristly greenbrier	Native	FAC								X
Solanum carolinense	Carolina horsenettle	Native	UPL	2	X	X	X		X		
Solanum rostratum	Buffalobur nightshade	Native	NL	0			X				
Solidago canadensis	Canada goldenrod	Native	FACU	2	X	X	X	X			
Solidago gigantea	Giant goldenrod	Native	FACW	3	X	X	X	X	X	X	X
Solidago sp.	Goldenrod	--	--		X						
Sonchus oleraceus	Common sowthistle	Introduced	FACU	0			X				
Spartina pectinata	Prairie cordgrass	Native	FACW	5	X	X	X	X	X		X
Sphenopholus obtusata	Prairie wedgescale	Native	FACW	5		X	X	X			X

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Sporobolus compositus	Composite dropseed	Native	FACU	3			X				
Stachys palustris	Marsh hedgenettle	Native	OBL	5							X
Symphoricarpos orbiculatus	Coralberry	Native	FACU-	2			X		X		
Symphyotrichum ericoides	White heath aster	Native	FACU	3			X				
Symphyotrichum lanceolatum	White panicle aster	Native	NI	2	X	X	X	X			
Symphyotrichum lateriflorum	Calico aster	Native	FACW	5	X			X	X		
Symphyotrichum novae-angliae	New England aster	Native	FACW	4	X						
Symphyotrichum ontarionis	Bottomland aster	Native	FAC	5	X			X	X		X
Symphyotrichum pilosum	Hairy white oldfield aster	Native	FACU	0	X		X	X	X		
Symphyotrichum praealtum	Willowleaf aster	Native	FACW	5	X	X	X	X	X		
Symphyotrichum puniceum	Purplestem aster	Native	OBL				X	X			
Symphyotrichum sp.	Aster	Native	--			X	X	X	X		
Taraxacum officinale	Common dandelion	Native & Introduced	FACU			X	X		X		
Teucrium canadense	Canada germander	Native	FACW	4	X	X			X		
Toxicodendron radicans	Eastern poison ivy	Native	FACU	2	X		X	X	X	X	X
Trifolium repens	White clover	Introduced	FACU		X	X					
Typha angustifolia	Narrowleaf cattail	Introduced	OBL				X				
Typha latifolia	Broadleaf cattail	Native	OBL	1	X		X				X
Ulmus americana	American elm	Native	FAC	3		X			X		
Ulmus pumila	Siberian elm	Introduced	NL						X		
Ulmus rubra	Slippery elm	Native	FAC	5	X						X
Ulmus sp.	Elm	--	--						X	X	
Unknown 1	Unknown seedling	--	--		X	X	X	X	X	X	X
Unknown 2	Unknown seedling	--	--		X		X		X		
Unknown Poaceae 1	Unknown grass	--	--		X	X	X		X		
Unknown Poaceae 2	Unknown grass	--	--				X				
Urtica dioica	Stinging nettle	Native & Introduced	FACW	1					X		X
Verbena hastata	Swamp verbena	Native	FACW	4	X	X	X				
Verbena simplex	Narrowleaf vervain	Native	NL	4		X					
Verbena stricta	Hoary verbena	Native	NL	2		X					
Verbesina alternifolia	Wingstem	Native	FAC	4	X						
Vernonia baldwinii	Baldwin's ironweed	Native	FACW-	3			X				
Vernonia fasciculata	Prairie ironweed	Native	FAC	4	X	X	X				
Veronicastrum virginicum	Culver's root	Native	FAC	9			X				
Viola nephrophylla	Northern bog violet	Native	FACW	8			X				

Appendix II - Comprehensive Vegetation Species List by Wetland, 2005-2012

Scientific Name	Common Name	Native Status	Status	C Value	W-68	W-100	W-25	W-5	W-51	W-54	W-55
Viola sp.	Violet	Native	--		X	X	X	X	X		X
Vitis riparia	Riverbank grape	Native	FAC	3	X	X	X		X	X	X
Vitis sp.	Grape	Native	--					X			

APPENDIX III

HYDROLOGICAL DATA

APPENDIX III - SECTION A

GROUNDWATER MONITORING WELLS

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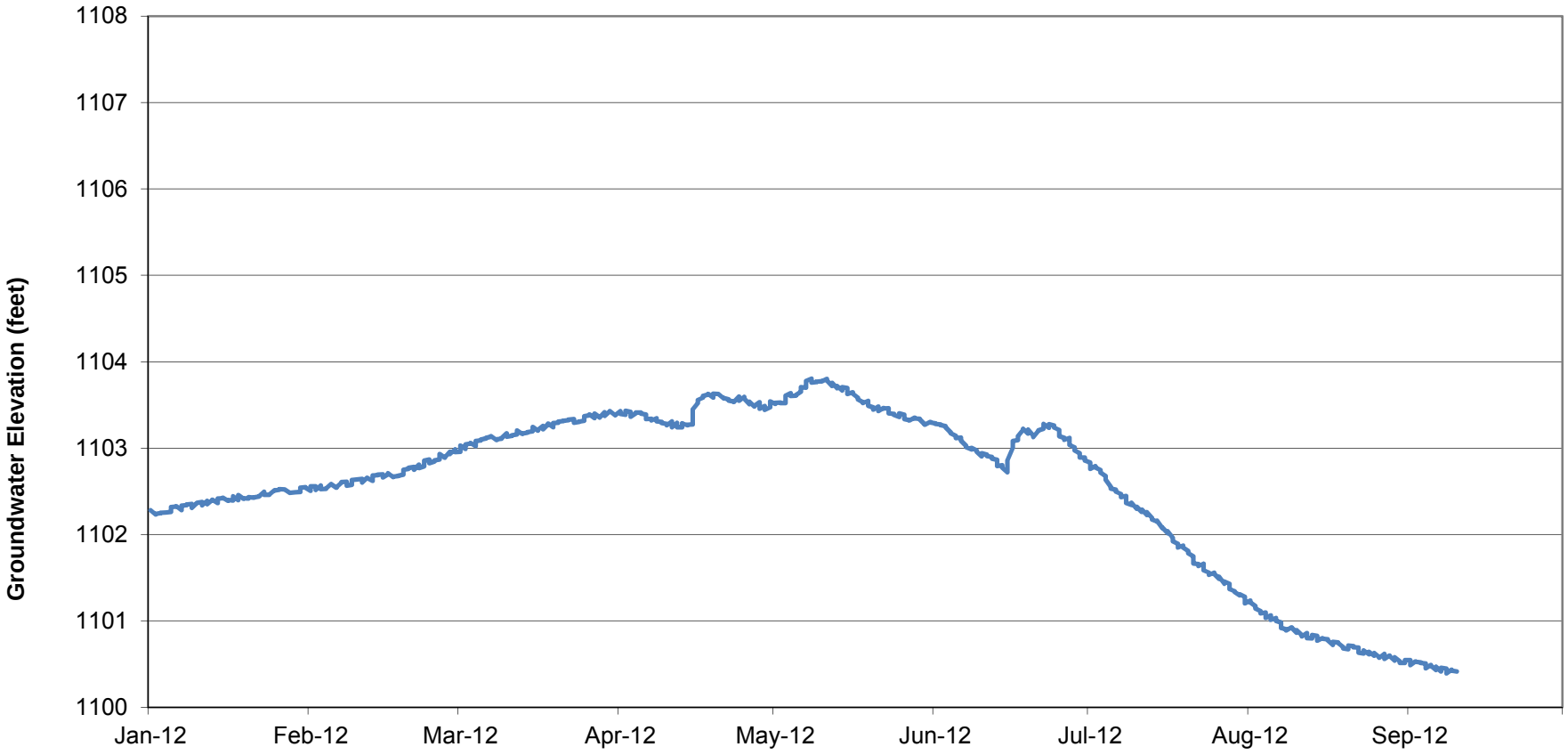
Figure 1 Monitoring Well Readings for MW 39A in Saunders County
(January 1, 2012 thru October 16, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 2 Monitoring Well Readings fro MW 90-05 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 3 Monitoring Well Readings fro MW 90-06 in Douglas County
(January 1, 2012 thru September 10, 2012)



Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 4 Monitoring Well Readings for MW 90-07 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 5 Monitoring Well Readings for MW 90-10 in Saunders County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 6 Monitoring Well Readings for MW 90-12 in Douglas County
(January 1, 2012 thru September 14, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 7 Monitoring Well Readings for MW 90-13 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 8 Monitoring Well Readings for MW 94-01 in Douglas County

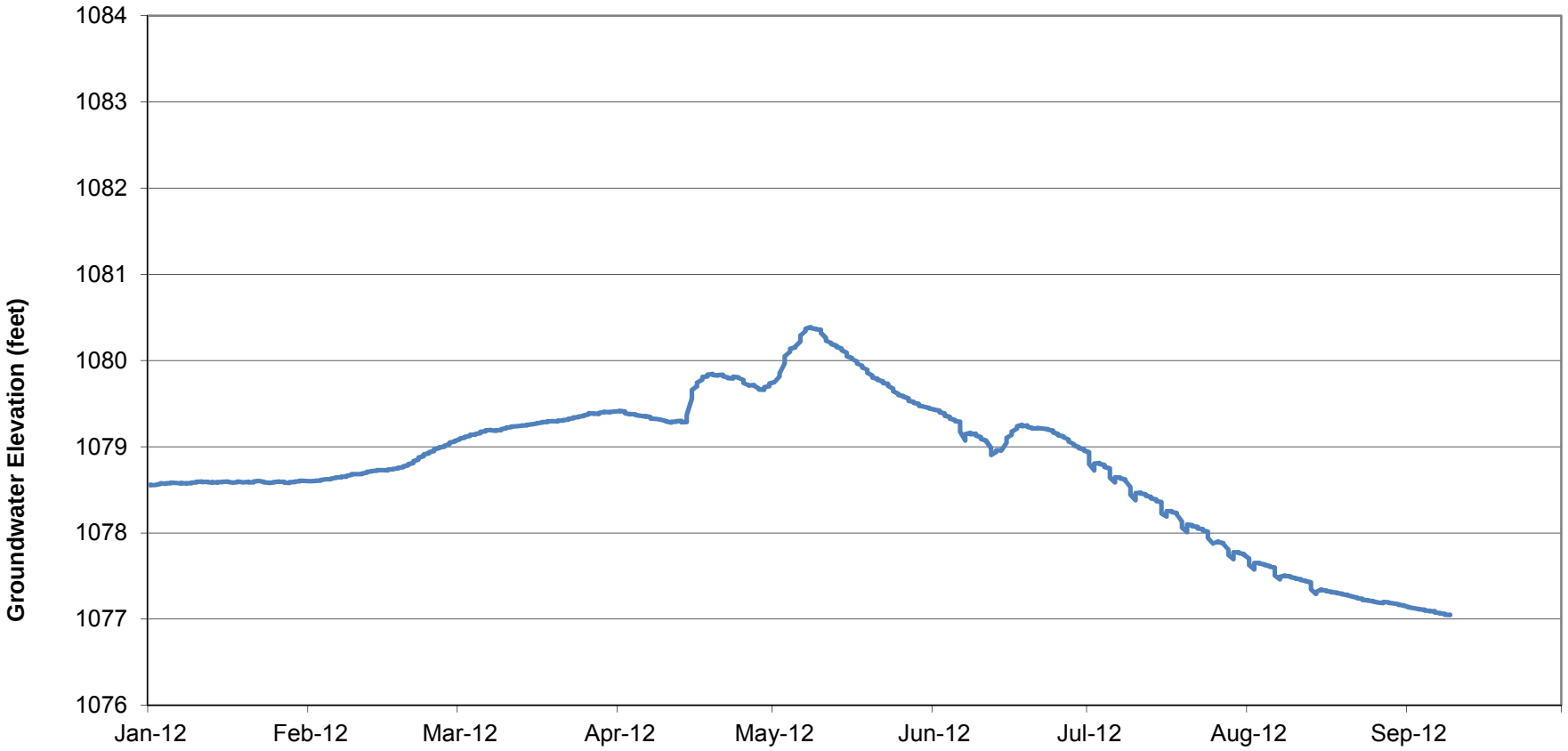
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 9 Monitoring Well Readings for MW 94-02 in Douglas County
(January 1, 2012 thru September 1, 2012)

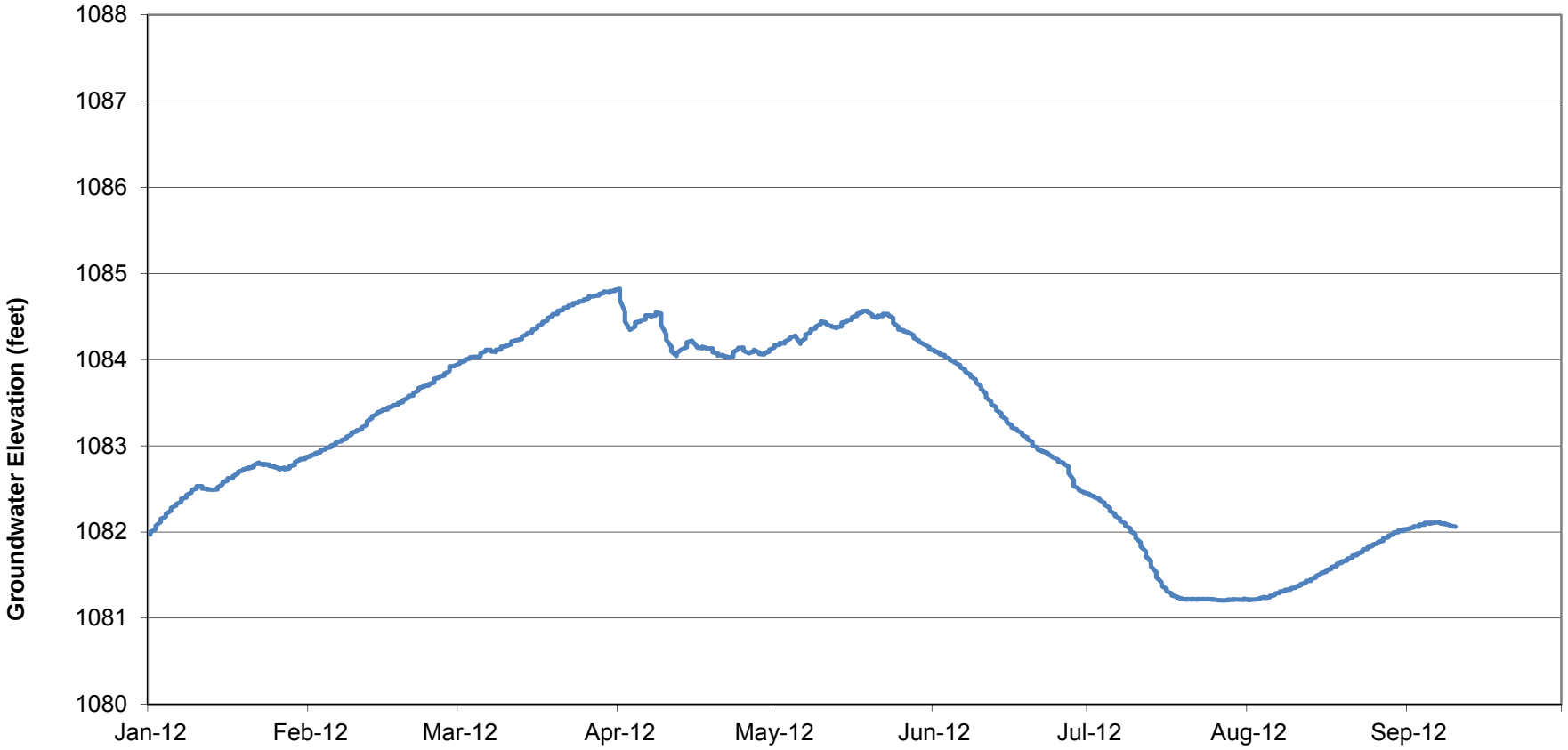
Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 10 Monitoring Well Readings for MW 94-03 in Saunders County
(January 1, 2012 thru September 9, 2012)



Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 11 Monitoring Well Readings for MW 94-04 in Saunders County
(January 1, 2012 thru September 10, 2012)



Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska.

Figure 12 Monitoring Well Readings for MW 94-05 in Saunders County
(January 1, 2012 thru September 11, 2012)

Note: Data obtained from Metropolitan utilities District, Omaha, Nebraska

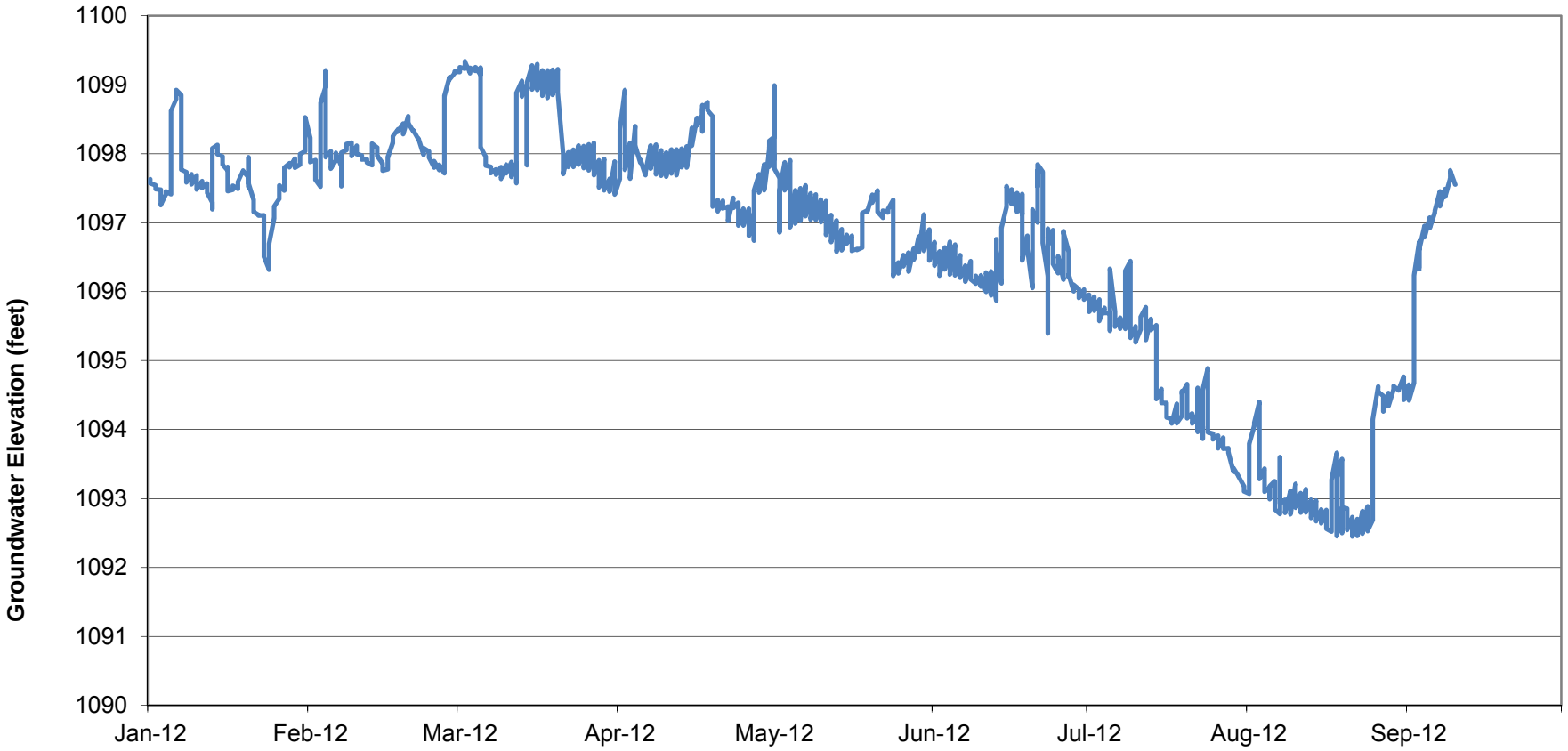
Figure 13 Monitoring Well Readings from MW 94-06 in Saunders County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 14 Monitoring Well Readings for MW 94-07 in Saunders County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 15 Monitoring Well Readings for MW 04-17 in Saunders County
(January 1, 2012 thru September 10, 2012)

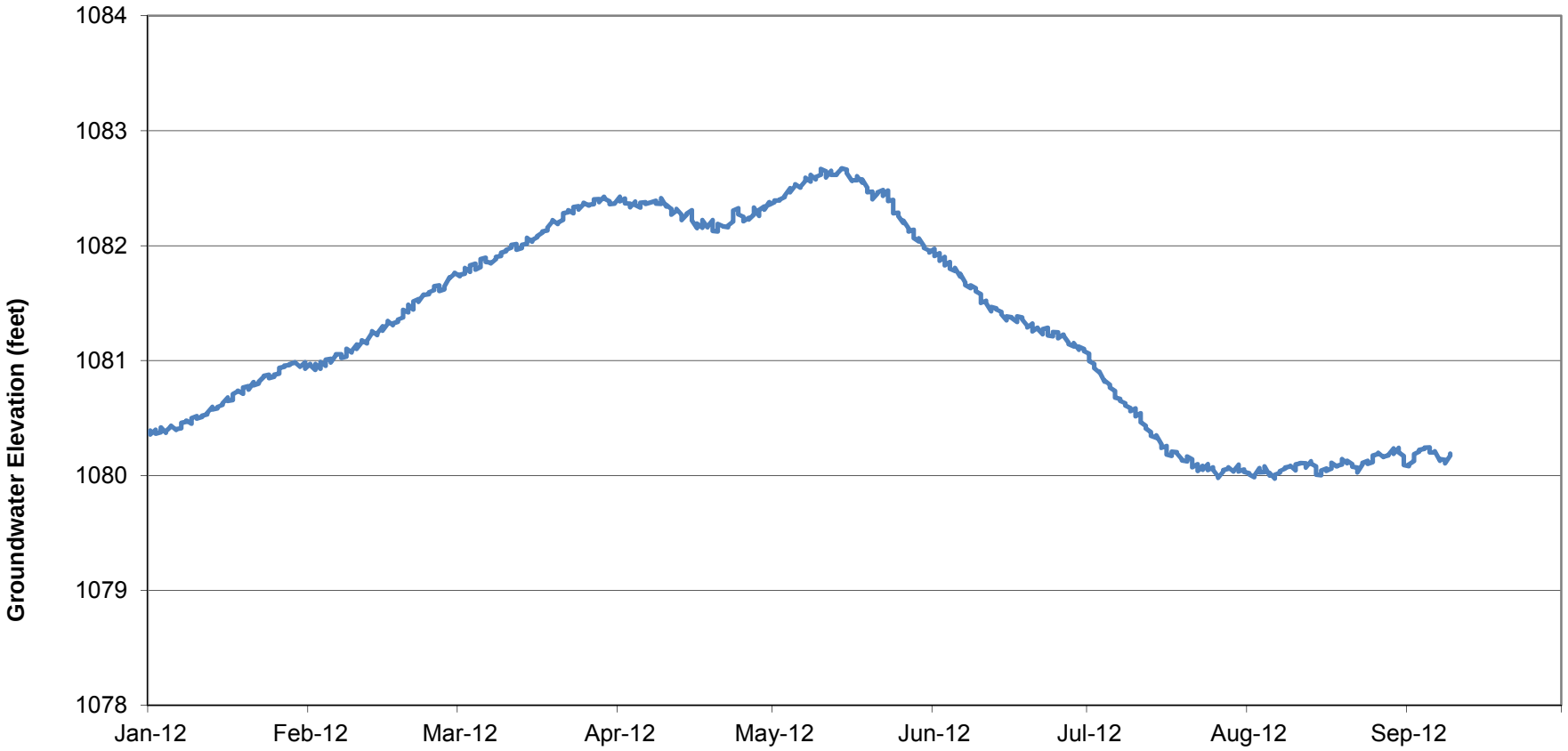


Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 16 Monitoring Well Readings for MW 05-22 in Saunders County
(January 1, 2012 thru September 9, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 17 Monitoring Well Readings for MW 05-23 in Saunders County
(January 1, 2012 thru September 9, 2012)



Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 18 Monitoring Well Readings from MW 05-24 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

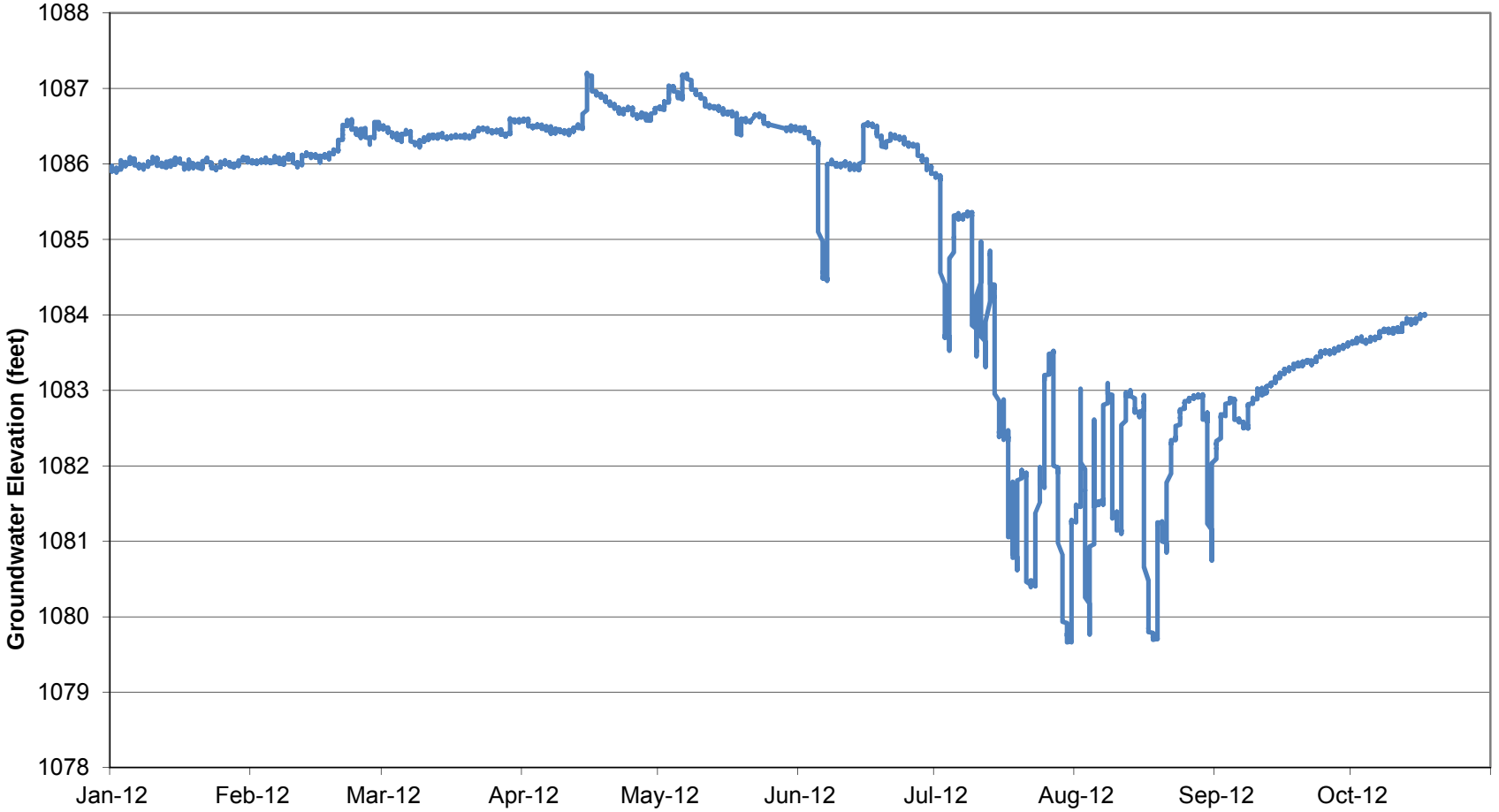
Figure 19 Monitoring Well Readings for MW 05-25 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 20 Monitoring Well Readings for MW 05-26 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 21 Monitoring Well Readings for MW 06-18 in Saunders County
(January 1, 2012 thru October 17, 2012)



Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 22 Monitoring Well Readins for MW 06-28 in Douglas County
(January 1, 2012 thru September 9, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

Figure 23 Monitoring Well Readings for MW 06-29 in Douglas County
(January 1, 2012 thru September 10, 2012)

Note: Data obtained from Metropolitan Utilities District, Omaha, Nebraska

APPENDIX III - SECTION B

PRODUCTION WELL DATA

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Table 1 2012 Production Well Pumping Rates, Total Million Gallons Per Day (MGD) - Douglas County Wellfield

WELL # (PW)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	YEARLY WELL DATA
94-2	1.95	0.59	0.00	0.00	0.07	56.89	81.22	15.00	8.92	30.38	41.30	236.32
91-3	0.00	0.00	0.37	6.92	2.51	9.73	34.40	29.12	58.03	6.49	0.00	147.57
04-4	0.00	0.70	0.18	0.00	0.82	0.00	0.00	0.00	0.00	0.13	0.00	1.83
04-5	0.00	0.00	0.73	1.17	1.46	1.38	0.47	0.00	0.00	0.12	0.00	5.33
04-6	14.75	0.05	0.00	11.65	13.44	52.16	47.42	3.59	58.67	1.91	26.91	230.55
04-7	4.46	4.86	0.00	0.00	9.97	7.89	10.52	7.37	0.00	0.06	0.00	45.13
04-8	0.00	0.00	0.11	0.00	0.00	0.10	1.39	0.00	25.95	0.17	26.43	54.15
04-9	0.00	0.00	0.00	0.00	0.00	0.00	3.36	4.38	0.00	0.49	10.16	18.39
04-10	27.31	0.55	19.61	95.38	55.14	88.08	74.38	72.25	38.98	33.86	41.59	547.13
04-11	49.90	18.41	4.20	2.00	1.00	7.21	30.32	8.99	9.75	0.31	2.84	134.93
04-12	55.87	9.31	40.68	2.66	70.00	9.17	0.01	25.65	12.36	27.41	0.00	253.12
04-13	0.00	0.00	0.58	0.00	0.00	0.00	15.34	7.44	25.44	0.13	0.00	48.93
04-14	12.13	10.06	0.73	19.76	0.01	19.60	63.37	23.57	3.47	1.00	0.00	153.70
04-15	14.76	58.07	27.27	32.35	45.66	42.94	76.11	78.79	52.15	57.91	31.44	517.45
04-16	0.15	0.00	0.27	3.51	53.93	37.41	86.66	13.29	26.75	12.34	56.99	291.30
04-17	43.01	6.82	37.06	61.72	79.68	71.04	66.28	43.77	19.89	51.09	5.16	485.52
Monthly Totals, MG	224.29	109.42	131.79	237.12	333.69	403.60	591.25	333.21	340.36	223.80	242.82	
Daily Averages, MGD	7.24	3.77	4.25	7.90	10.76	13.45	19.07	10.75	11.35	7.22	8.09	

Table 2 2012 Production Well Pumping Rates, Total Million Gallons Per Day (MGD) - Saunders County Wellfield

WELL # (PW)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	YEARLY WELL DATA
91-30	38.14	0.00	5.88	33.31	10.30	62.15	25.84	0.00	0.00	7.69	11.70	195.01
94-31	8.43	23.46	0.50	73.92	39.36	90.76	37.26	27.13	90.47	30.79	0.00	422.08
94-32	0.00	57.02	36.61	0.00	25.54	0.00	32.84	1.36	64.82	7.31	11.73	237.23
94-33	64.28	3.13	0.00	0.00	8.25	72.20	13.78	0.00	0.00	0.00	74.03	235.67
94-34	0.00	69.83	56.93	86.37	98.14	23.03	81.34	58.71	66.61	55.14	37.67	633.77
94-35	71.43	0.00	27.65	1.53	10.86	35.85	91.21	77.14	84.40	56.64	20.00	476.71
94-36	78.50	0.39	32.92	45.03	24.32	81.47	108.42	111.79	83.26	54.63	47.69	668.42
94-37	0.00	97.50	117.18	111.92	5.46	0.00	55.04	123.00	98.97	66.05	91.75	766.87
04-38	0.00	11.83	0.59	87.12	57.15	46.22	99.41	104.14	66.76	48.14	23.80	545.16
04-39	80.75	84.38	36.65	1.63	23.62	57.26	65.03	93.66	61.85	72.70	27.33	604.86
04-40	14.95	0.02	24.44	40.76	105.28	76.09	88.24	79.86	62.87	40.88	42.75	576.14
04-41	0.00	16.49	0.00	31.03	12.01	0.00	8.07	0.00	0.00	18.34	11.51	97.45
04-42	90.83	0.00	0.99	0.00	0.00	50.69	48.24	0.00	27.45	0.35	19.28	237.83
04-43	3.91	0.05	60.50	56.05	42.95	25.88	0.00	0.00	0.00	5.29	70.12	264.75
04-44	0.00	25.23	0.00	0.31	63.64	17.50	32.66	0.00	0.00	43.23	36.19	218.76
04-45	83.95	11.63	0.00	1.20	94.90	76.91	100.31	97.25	58.83	39.36	63.91	628.25
04-46	21.61	20.89	0.00	17.19	68.25	74.74	63.83	30.30	53.21	51.30	34.40	435.72
04-47	0.00	0.00	0.00	24.88	27.88	39.98	12.43	0.00	0.00	3.46	0.47	109.10
04-48	41.95	0.00	4.83	4.82	39.12	15.21	31.03	0.00	0.00	0.00	19.53	156.49
04-49	23.38	27.05	59.22	93.94	61.46	62.16	81.86	37.08	51.18	59.99	24.23	581.55
04-50	0.00	4.19	4.75	5.23	0.00	39.52	14.24	0.00	0.00	0.76	0.41	69.10
04-51	0.00	0.00	0.13	0.00	60.08	28.29	12.71	0.00	0.00	0.59	9.08	110.88
04-52	0.00	7.52	53.54	33.91	19.91	55.91	37.37	0.00	0.00	0.00	40.71	248.87
04-53	43.31	19.63	0.31	0.00	10.60	0.00	4.68	5.71	29.93	0.00	0.05	114.22
04-54	0.00	0.00	0.35	14.62	1.26	4.81	0.00	0.00	0.00	0.41	17.23	38.68
04-55	16.31	0.00	0.27	0.00	7.43	0.00	17.94	0.00	0.00	0.11	3.92	45.98
Monthly Totals, MG	681.73	480.24	524.24	764.77	917.77	1036.63	1163.78	847.13	900.61	663.16	739.49	
Daily Averages, MGD	21.99	16.56	16.91	25.49	29.61	34.55	37.54	27.33	30.02	21.39	24.65	

APPENDIX III - SECTION C

PIEZOMETERS

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Figure 1 2012 Piezometer Readings for PEM Wetland 25

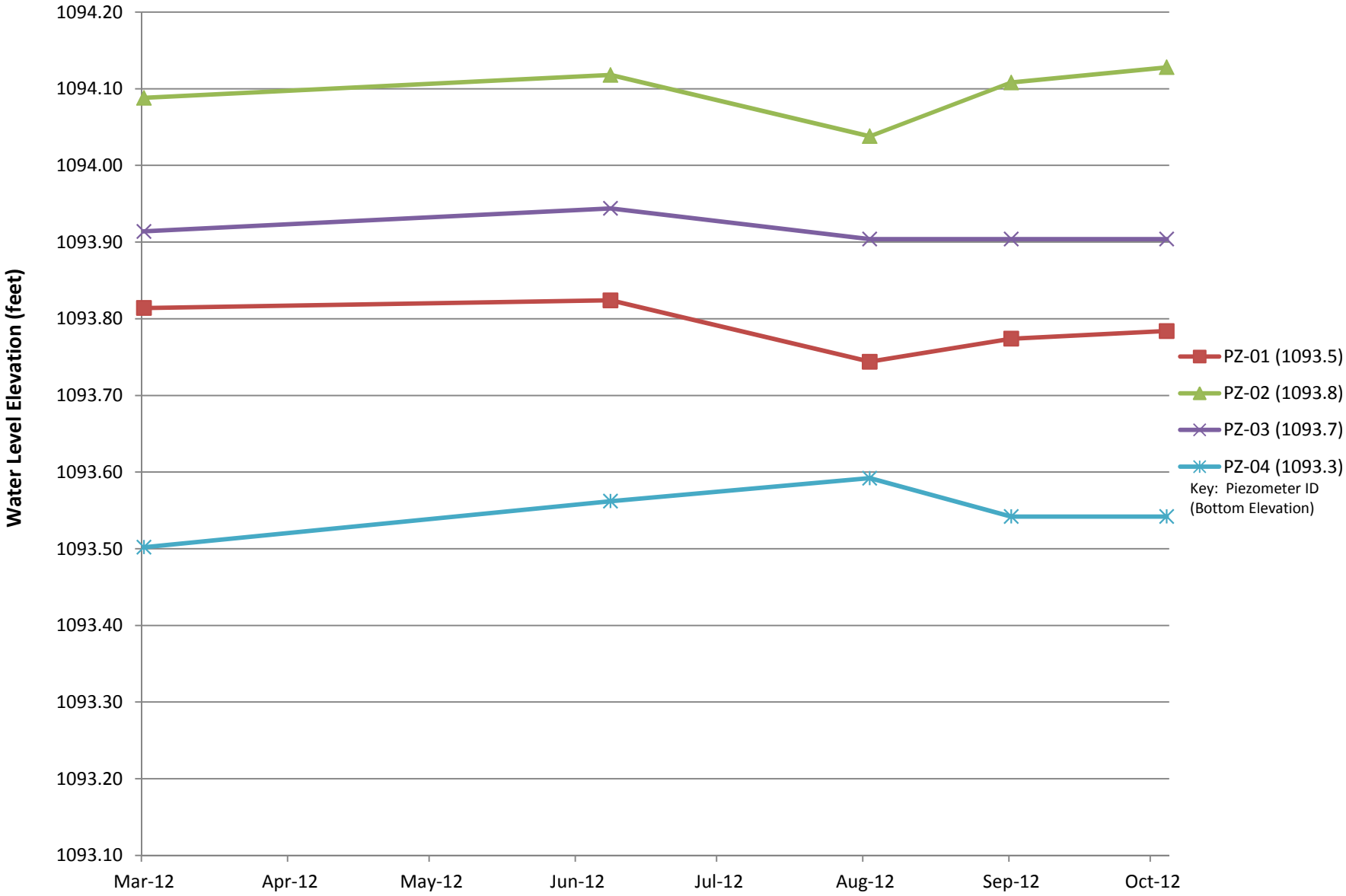


Figure 2 2012 Piezometer Readings for PFO Wetland 5

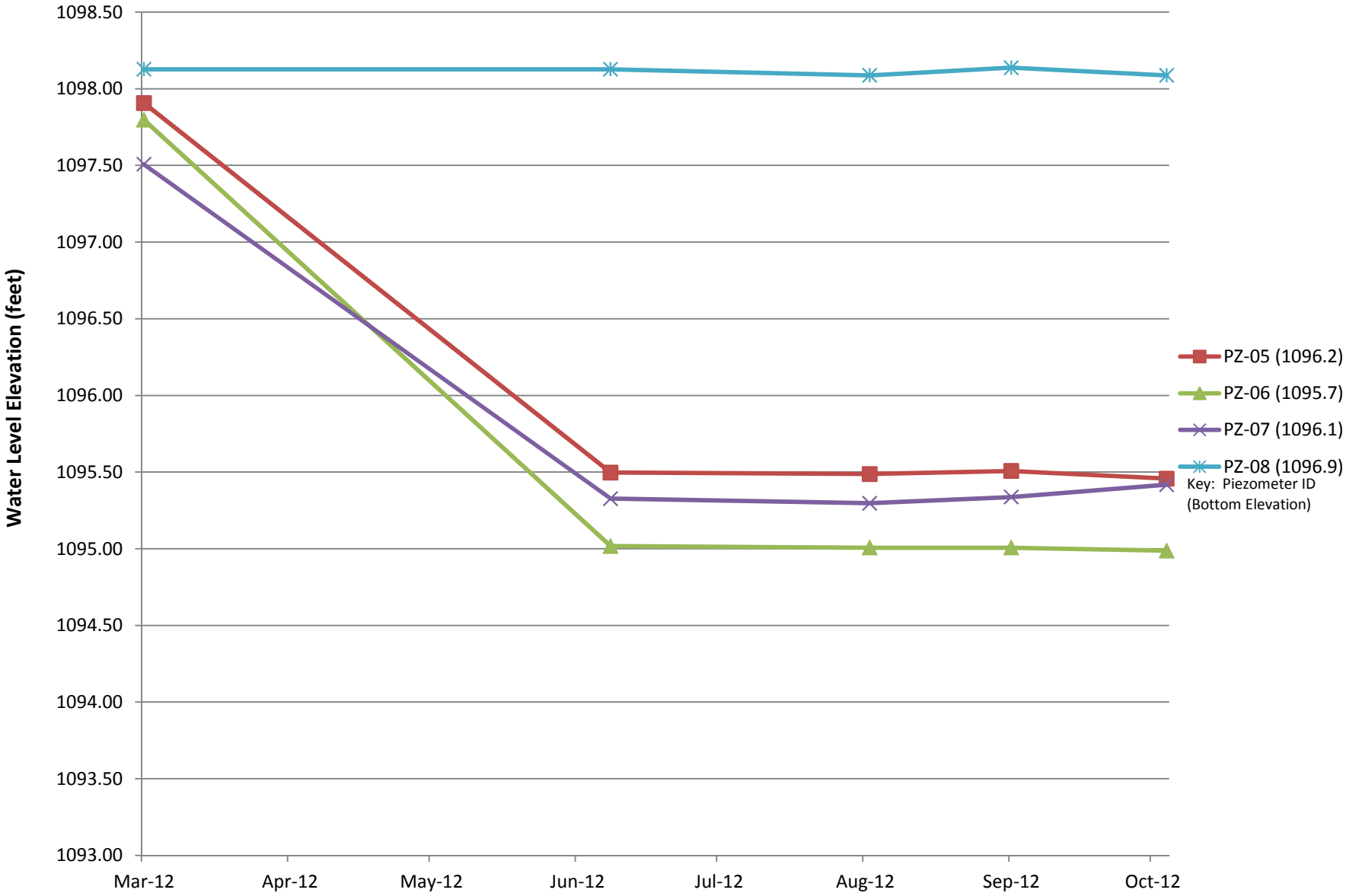


Figure 3 2012 Piezometer Readings for PEM Wetland 100

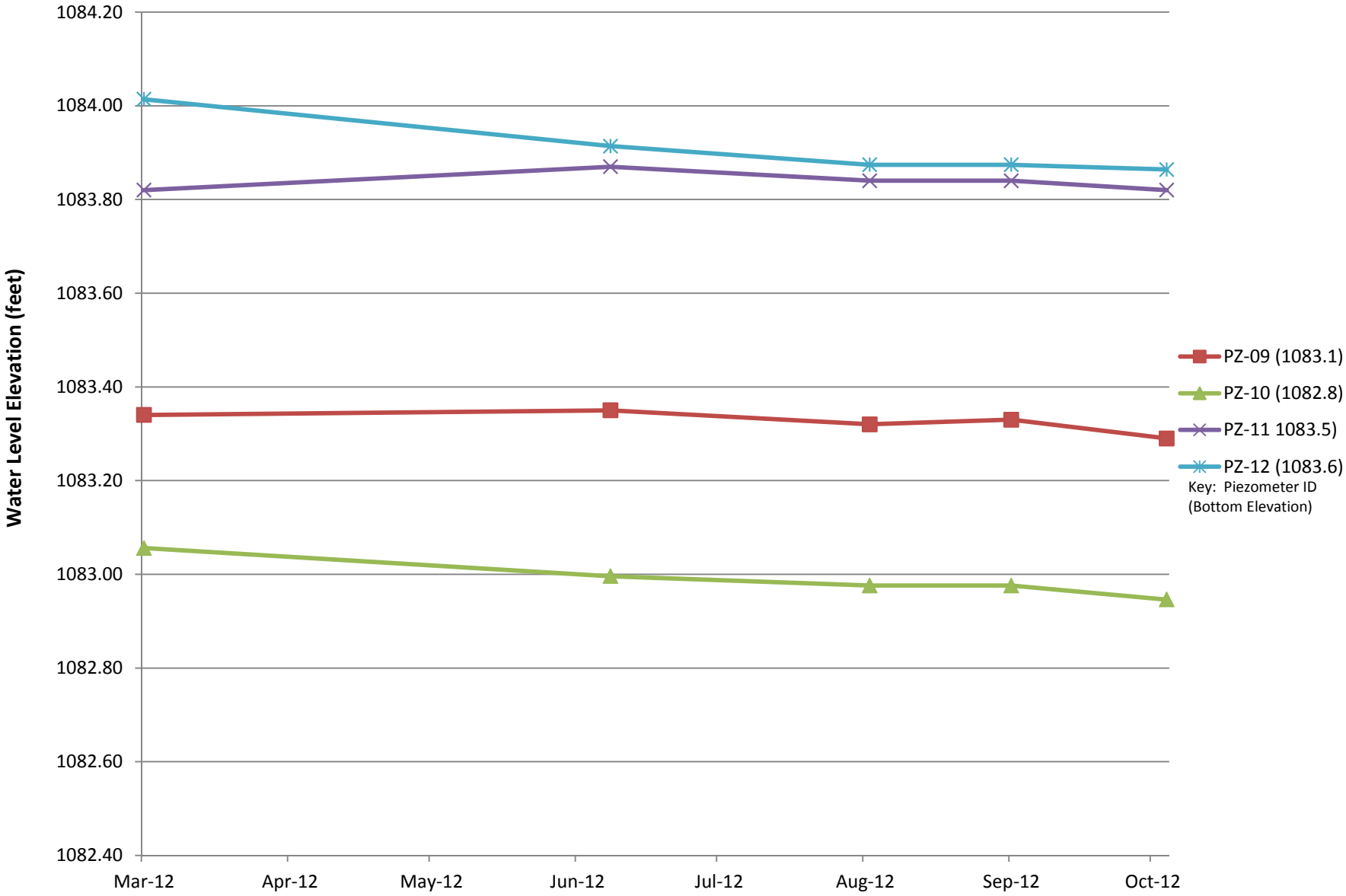
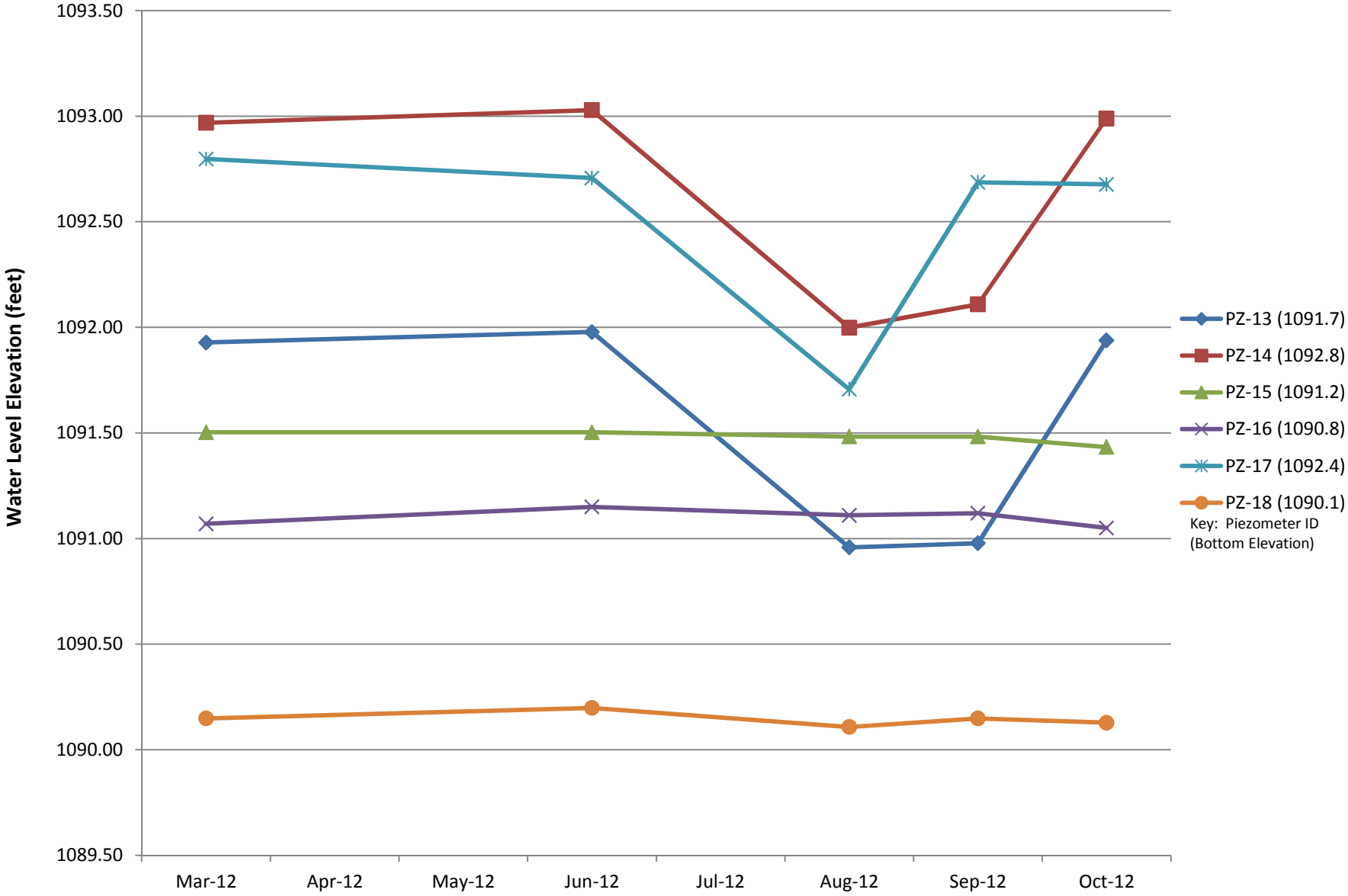


Figure 4 2012 Piezometer Readings at the Phase I and Phase II Wet Meadow Mitigation Sites (WM-1 and WM-2)



APPENDIX III - SECTION D

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Figure 1 2012 Total Monthly Precipitation
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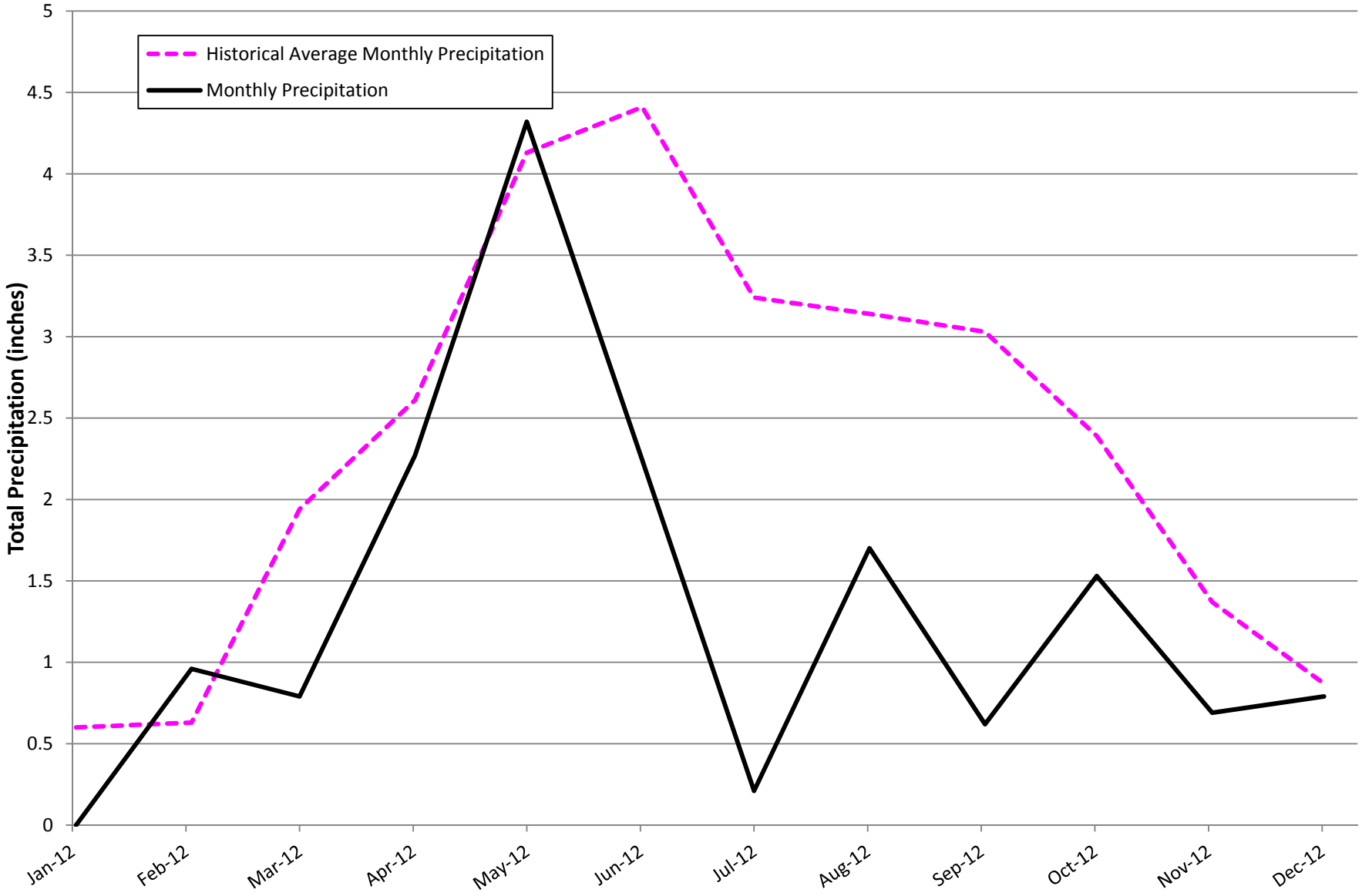


Figure 2 2012 Monthly Average Ambient Air Temperature
Fremont, NE

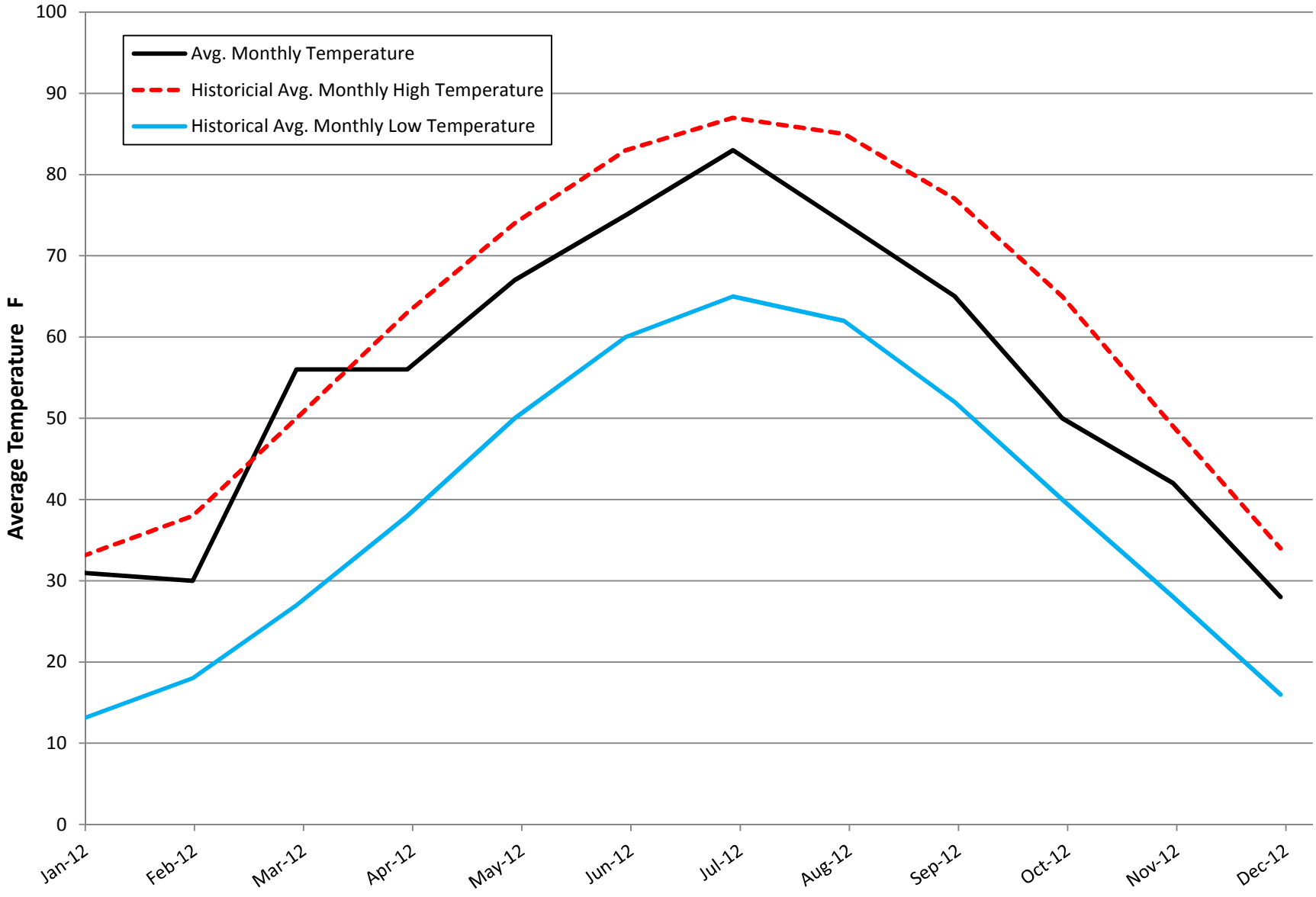
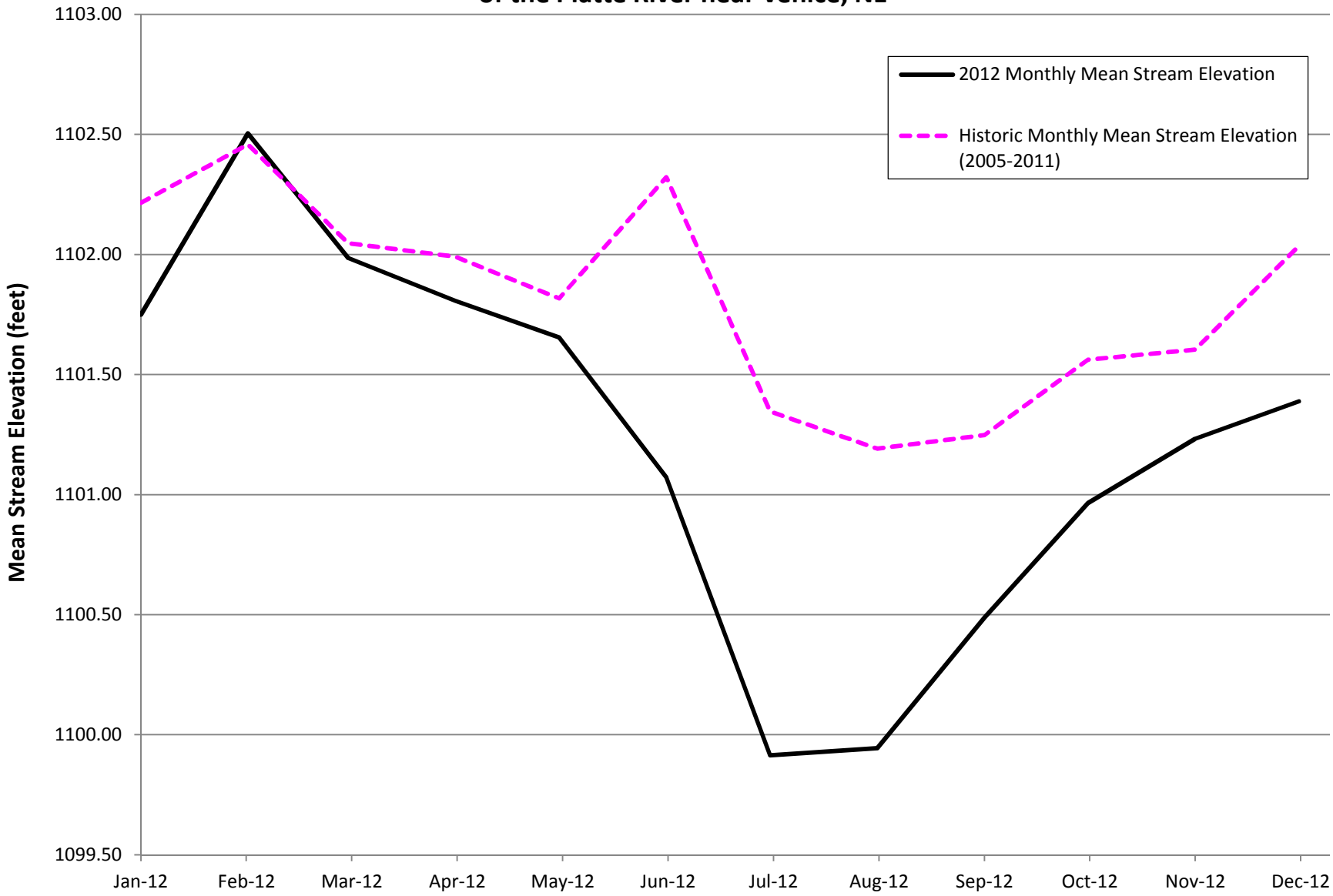
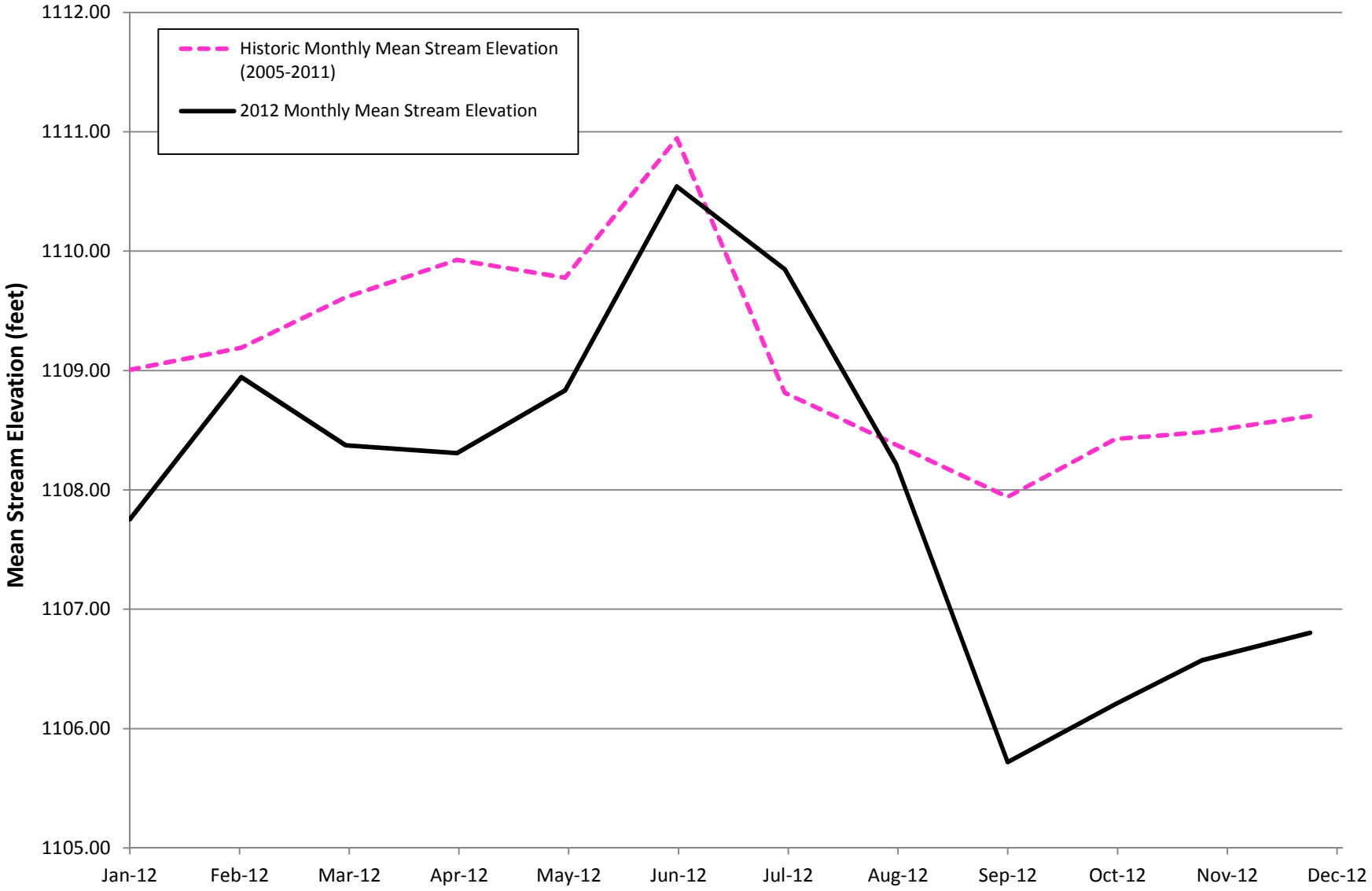


Figure 3 2012 Monthly Mean Stream Elevation of the Platte River near Venice, NE



Source: USGS. 2012b. National Water Information System: Platte River near Venice, Nebraska 06796500.

Figure 4 2012 Monthly Mean Stream Elevation of the Elkhorn River at Waterloo, NE



Source: USGS. 2012a. National Water Information System: Elkhorn River at Waterloo, Nebraska 06800500.

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