

# Voluntary Integrated Management Plan 2014 and 2015 Annual Report

**DRAFT – APRIL 2016**

Prepared By:

Papio-Missouri River  
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**Confluence of the Platte and Elkhorn Rivers**

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## 1.0 INTRODUCTION

The citizens of the Pappio-Missouri River Natural Resources District (P-MRNRD) depend on abundant, clean water in their homes for domestic use, on their farms for agricultural production, and for their industries to maintain economic viability. Wildlife that live and migrate through the P-MRNRD depend on clean water for sustenance and habitat. Furthermore, human inhabitants of the District use water in rivers and lakes for recreation including fishing, hunting, boating, and swimming. Without available water, our ancestors would not likely have settled here on the prosperous lands adjacent to the Platte, Elkhorn and Missouri Rivers.

Both rural and urban inhabitants along the Lower Platte River from the Elkhorn to the Missouri River have relied on the abundant water resources of the area and over time their water use has increased. Following the drought of 2012, it was clear to leaders at the P-MRNRD and citizen stakeholders within this area that a water use plan needed to be developed to provide a framework for how to wisely manage water resources so that they are available now and in the future.



Confluence of the Platte and Missouri Rivers

For these reasons, water management planning was voluntarily initiated by the P-MRNRD in collaboration with the Nebraska Department of Natural Resource (NDNR). The plan, called an Integrated Management Plan (IMP), is a water planning document that provides a framework for how the P-MRNRD and the NDNR will work collaboratively to manage groundwater and surface water use across an area where the two are hydrologically connected. The IMP was initiated voluntarily by the P-MRNRD in part to avoid future determinations by NDNR that the area is fully appropriated.

Not only did the P-MRNRD volunteer to initiate a IMP, numerous local stakeholders volunteered to represent the wide array of water interests and provide invaluable input during the planning process. These stakeholders truly shared the insight and discussions necessary to not only develop a plan, but to carry it forward into the future. We are grateful for all their time and energy!

## **1.1 BACKGROUND AND PURPOSE**

This IMP was developed jointly by the P-MRNRD and NDNR with the express purpose to manage the hydrologically connected portions of the P-MRNRD to achieve and sustain a balance between water uses and water supplies for the long term. The IMP provides the regulatory background as well as the detailed goals, objectives, and action items that were developed with stakeholder involvement. This IMP was developed with the understanding that the Lower Platte River Basin is not fully appropriated; should that designation change, the IMP would have to be reevaluated.

The P-MRNRD Voluntary IMP, dated August 2014, was adopted by P-MRNRD Board of Directors on July 10, 2014 and associated groundwater control rules and regulations were enacted on November 13, 2014. On August 1, 2014, the NDNR issued an order adopting the P-MRNRD IMP and associated surface water controls.

As this IMP is being entered into on a voluntary basis, the IMP area is not currently fully appropriated. The methodology proposed by NDNR to assess the available supplies and uses, known as INSIGHT, for future Annual Reports will be utilized to track depletions and gains to streamflow from changes in availability and use. Current supplies are greater than the current level of use and therefore methods to identify water supplies to be used as offsets or for mitigation purposes or an identification de minimis effects are not included in this IMP. Additionally, the IMP area is not subject to any interstate compact or decree, or any other formal contract or agreement pertaining to surface water or groundwater use or supplies.

## **1.2 AUTHORITY**

This IMP was prepared for and adopted by the Board of Directors of the P-MRNRD and the NDNR in consultation with the P-MRNRD Stakeholder Advisory Committee. P-MRNRD Board Meeting minutes adopting the IMP and enacting groundwater control rules and regulations are enclosed in Appendix A along with NDNR's letter of agreement and order of adoption. As stated in Neb. Rev. Stat. § 46-715(1)(b), a natural resources district encompassing a river basin, subbasin, or reach that has not been designated as overappropriated or has not been finally determined to be fully appropriated may, jointly with the department, develop an integrated management plan for such river basin, subbasin, or reach located within the district.

## 2.0 2015 DATA COLLECTION AND MONITORING

Section 6 (page 19) of the adopted IMP describes the annual monitoring plan to be followed in completing the following actions:

- Gather and evaluate data, information, and methodologies that could be used to accomplish the purpose of this IMP
- Increase understanding of the surface water and hydrologically connected groundwater system
- Test the validity of the conclusions and information upon which the IMP is based

## 2.1 P-MRNRD DATA COLLECTION AND MONITORING

The P-MRNRD is responsible for collecting, tracking, evaluating, and reporting the following activities within the IMP Area on an annual basis:

- Groundwater level measurements
- Municipal, commercial, and industrial annual water use
- Irrigation water use
- Well registrations approved, cancelled or denied (or well permitting if well permitting requirements are implemented)
- Variances granted, cancelled or denied
- Water transfer permits granted, cancelled, or denied
- Water banking transactions (if a water banking system is established)

### Groundwater Level Measurements

Groundwater level measurements were collected at 22 locations within the IMP area during the spring and fall of 2014 and 2015. Figure 1 in Appendix D displays the standard deviation and approximate number of records for each groundwater level measurement location. Some sites have been measured since 1978. Figure 2 shows the Spring 2015 groundwater level elevation measured from bare-earth LiDAR flown in 2010 and illustrates how much variation this measurement had versus the average groundwater level from the period or record. In general, groundwater level data for the IMP area shows a standard deviation between 0 and 2 feet. Additionally, this years Spring 2015 measurements were generally in line with that standard deviation experiencing changes from the average of -1 to +3 feet.

## Municipal, Commercial and Industrial Annual Water Use

Municipal Well Field	2014 Total Pumped (Ac-ft)	2015 Total Pumped (Ac-ft)	Notes
Papillion	3,973.5	3,739.3	
Lincoln	7,541.4	15,932.6	Only horizontal wells in P-MRNRD
MUD South	34,346.9	33,185.1	
MUD West	9,509.0	9,160.2	Includes only wells in P-MRNRD
Fremont	4,755.4	4,519.1	Includes only wells in P-MRNRD
Valley	306.8	331.7	
Springfield	170.5	165.7	
Gretna	961.6	907.8	
Arlington	199.2	198.3	
<b>TOTAL</b>	<b>61,764.2</b>	<b>68,139.7</b>	

## Irrigation Water Use

No data was collected during 2014 or 2015. The P-MRNRD is in the process of mapping and certifying irrigated acres in the IMP area. Upon completion, this information will be used with water use calculations from the previous P-MRNRD Water Balance Study to estimate irrigation water use for subsequent annual reports.

## Well Registrations

All new registered wells during 2014 and 2015 for the IMP area are available online through NDNR at <http://data.dnr.nebraska.gov/wells/Menu.aspx>. No well permits are currently issued by the P-MRNRD as part of their Groundwater Management Plan.

## Vaiances to Expand Irrigated Acres

The P-MRNRD received and approved 9 variances to expand a total of 470 irrigated acres in the IMP area during 2014, reference Table 1.

**Table 1. 2014 Variances to Expand Irrigated Acres**

Application Number	Approval Date	Acres	Status	Registered Well
V-0037	01/09/14	80	Complete	G-058057

V-0038	02/19/14	65	Complete	G-172243
V-0039	03/10/14	34	Conditional	No well registered
V-0040	03/10/14	9	Complete	G-169064
V-0041	03/10/14	12	Complete	G-169064
V-0042	04/18/14	45	Complete	G-173267
V-0043	04/18/14	65	Complete	G-173266
V-0045	09/09/14	80	Complete	G-173724
V-0046	02/03/14	80	Complete	G-175644

The P-MRNRD received and approved 3 variances to expand a total of 95 irrigated acres in the IMP area during 2015, reference Table 2.

**Table 2. 2015 Variances to Expand Irrigated Acres**

Application Number	Year	Acres	Status	Registered Well
V-0047	2015	35	Conditional	
V-0048	2015	40	Conditional	
V-0049	2015	20	Conditional	

### **Water Transfer Permits**

The P-MRNRD does not currently require any Water Transfer Permits.

### **Water Banking Transactions**

The P-MRNRD does not currently operate a Water Bank.

## **2.2 NDNR DATA COLLECTION AND MONITORING**

NDNR will be responsible for collecting, tracking, evaluating, and reporting the following activities within the IMP Area on an annual basis:

- NDNR stream gage measurements
- Surface water permits issued, cancelled or denied
- Irrigation water use data collected
- Annual water use by the Metropolitan Utilities District and Lincoln Water System

Annual data collection and monitoring completed by NDNR for 2014 and 2015 is included as part of their report.

### **3.0 GOALS AND OBJECTIVES**

Reference Section 3 (page 9) of the IMP for the the four goals and corresponding objectives developed by the P-MRNRD and NDNR, in consultation with the Stakeholder Advisory Committee.

#### **3.1 P-MRNRD ACCOMPLISHMENTS TOWARD GOALS AND OBJECTIVES**

Objectives for each goal are supported by action items as documented in Section 4 (page 11) of the IMP. For 2014, the only regulatory action item to be implemented by the P-MRNRD was the groundwater control action item which established an annual limit on the expansion of groundwater-irrigated acres within the District to 2,500 acres. The P-MRNRD allowed for development of 470\_acres in 2014 and 95\_acres in 2015.

A proposed schedule and status of the accomplishments toward other action items as part of the goals and objectives up to the end of 2015 is recorded in table format in Appendix C.

#### **3.2 NDNR ACCOMPLISHMENTS TOWARD GOALS AND OBJECTIVES**

Accomplishments toward IMP Goals and Objectives completed by NDNR for 2014 is included as part of their report.

### **4.0 INFORMATION AND EDUCATION**

Information and education about the efficient and effective use of water for both our rural and urban landscapes was very important to stakeholders during the development of the IMP and is encapsulated in the goals, objectives, and action items under Goal 3. District newsletters provide information regarding specific programs and projects as does our website at [www.papionrd.org](http://www.papionrd.org). Each year, the P-MRNRD office at Chalco Hills is host to the World O' Water public event in which 2,000 to 2,200 children and adults attend. Event planners and participants include the P-MRNRD, City of Omaha Stormwater Program, Keep Omaha Beautiful, Papillion Creek Watershed Partnership, Nebraska Game and Parks Commission, AWWA, Groundwater Foundation, MUD, USGS, U.S. Army Corps of Engineers, and Upper Big Blue NRD. Attendees hear and obtain information regarding local and Nebraska groundwater and surface water issues, there are also



great hands-on activities. The P-MRNRD is planning to have a future booth in 2016 focused on water conservation and efficiency relating to lawn and crop irrigation.

In May, P-MRNRD staff also coordinate an annual Water Works Festival for 900 to 1,000 5<sup>th</sup> and 6<sup>th</sup> grade students. Over the course of this reporting period, P-MRNRD information and education staff has completed over 50 school or public visits to provide water-based education to approximately 4,000 people each year.

## 5.0 INCENTIVE PROGRAMS

The P-MRNRD will evaluate the implementation of cost-share incentive programs that promote water conservation practices. For example, P-MRNRD will explore cost-share incentives for voluntary installation of soil moisture and ET sensors. Incentive programs may include any program authorized by state law or federal programs. Water users or landowners may be required to enter into and perform such agreements or covenants concerning the use of land or water as are necessary to produce the benefits for which the incentive program is established. Furthermore, the P-MRNRD will explore grant opportunities and NRCS programs to supplement the annual budgeting process for funding action items. Educational and training programs may be included with the cost-sharing and grant-funding sources.

## 6.0 MODIFICATIONS TO THE INTEGRATED MANAGEMENT PLAN

P-MRNRD and NDNR held a joint coordination meeting on March 31, 2016 to evaluate the results of the IMP for 2014 and 2015. As a part of planning for the annual review meeting. It was agreed by both parties, that action items undertaken by the P-MRNRD and NDNR seemed to be fulfilling the goals and objectives of the IMP. Therefore, the NDNR and P-MRNRD jointly determined that no amendments to the IMP are necessary for this annual review. If amendments to the IMP are deemed necessary in future annual reviews,, the P-MRNRD and NDNR will hold a joint public hearing prior to adopting such amendments.

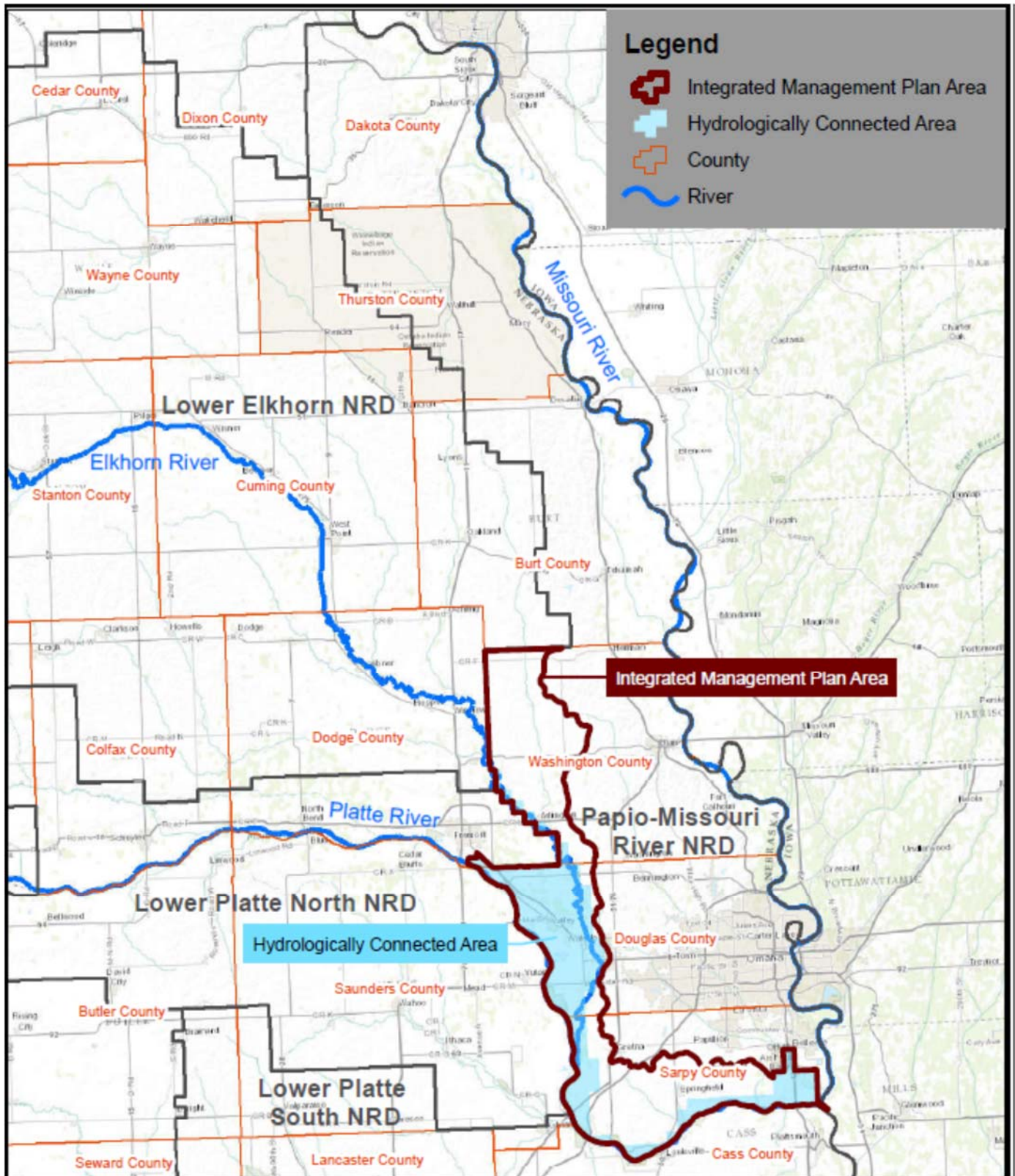
## 7.0 PRIORITY ACTION ITEMS FOR THE FOLLOWING YEAR

The priority action items for the following year were discussed at the Annual P-MRNRD and NDNR review meeting on March 31, 2016. Minutes from this meeting are enclosed in Appendix D. The following items are listed as priority actions for calendar year 2016:

- Continue GWMP Update
- Participate with LPSNRD, LPNDR, MUD, and LWS, and NDNR in a water conveyance study for Lower Platte River. Also coordinate with LENRD on their conjunctive management study.

- Coordinate with NDNR to obtain the best available land use data for 2015 and possibly 2017.
- Fund and implement Platte and Elkhorn River Valley Integrated Water Monitoring study with USGS
- Fund and implement Springfield AEM flight and data interpretation utilizing IDEP and WSF grant funds
- Plan and provide information at World O' Water event on September 10, 2016
- Work cooperatively to further develop Lower Platte River Basin Plan

## FIGURES



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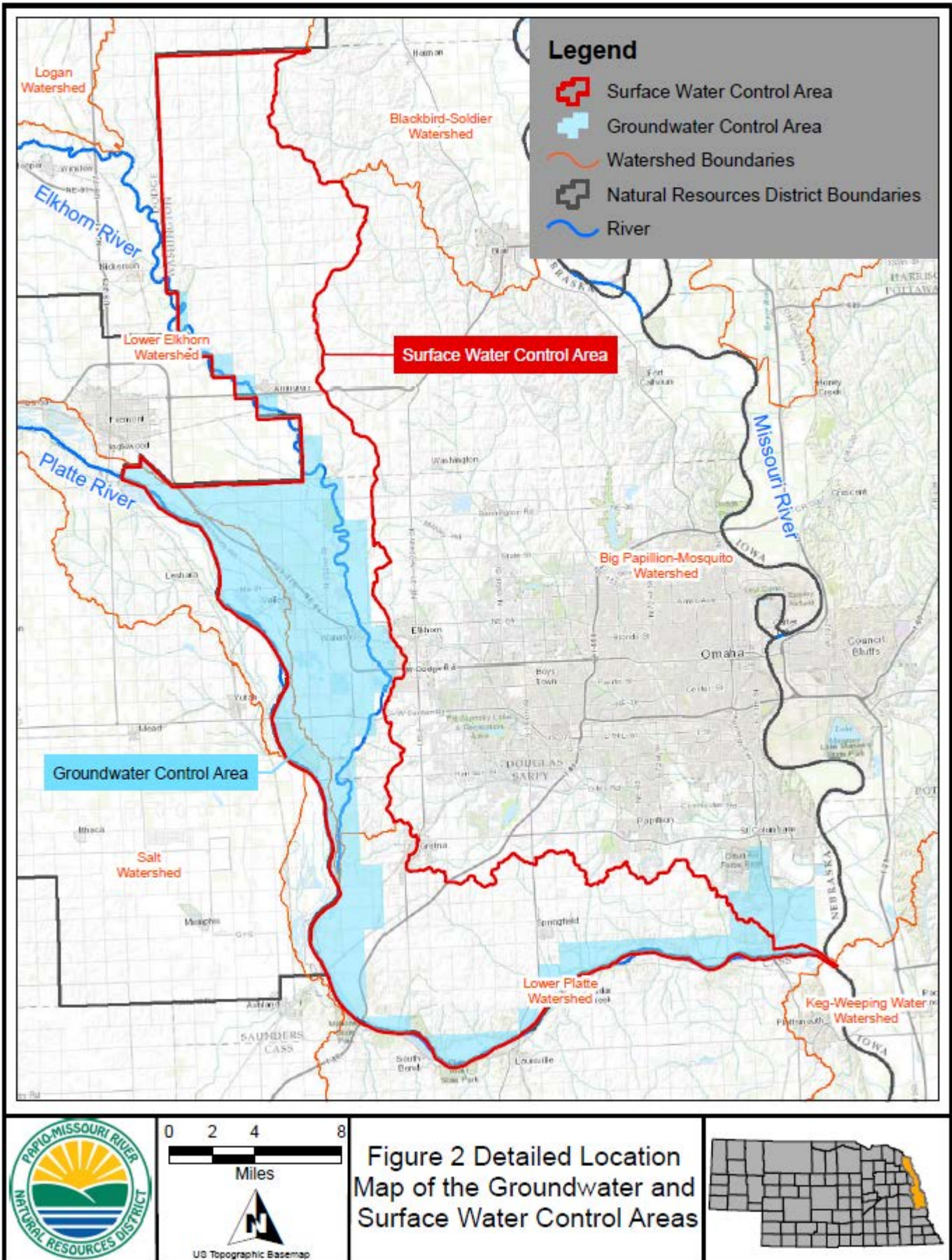
Miles



US Topographic Basemap

Figure 1 General Location Map of the Integrated Management Plan Area





**APPENDIX A**  
**IMP Adoption Documents**

Agenda Item: 6.

## Memorandum

**To:** Programs, Projects and Operations Subcommittee  
**From:** Brian L. Henkel, Groundwater Management Engineer  
**Date:** May 2, 2014  
**Re:** Draft Voluntary Integrated Management Plan for the Lower Platte River

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In November 2011 the Board authorized Management to initiate the process of developing a voluntary Integrated Management Plan (IMP) for the Lower Platte River portion of the District. An IMP is a proactive approach to the management of the water resources through coordinated planning with the Nebraska Department of Natural Resources (Department) that offers greater flexibility of management for both surface water and groundwater. Integrated management recognizes the interconnectedness of these waters and develops strategies to ensure a balance between water uses and water supplies for the long term.

District staff, Department staff, and Olsson Associates assembled a Stakeholder Advisory Committee (SAC) to solicit input from water users in the Lower Platte River to determine their collective goals and objectives for the interconnected water resources. The SAC included representatives from agriculture, industry, municipal supply, environmental and recreational groups, cities, and counties as well as technical advisors from the state and federal level. The Board adopted the goals and objectives proposed by the SAC on September 8, 2013. From those goals and objectives a set of action items was developed to guide the District and the Department to meet the adopted objectives and move toward the goals. The draft IMP proposed for adoption (attached), is the planning tool the District and the Department will use to ensure the long term viability of the interconnected water resources of the Lower Platte River.

Adoption of this draft IMP is the first step in the process of adoption and implementation. Should the Board adopt this draft IMP, the June Board meeting will include a public hearing on the draft IMP. Adoption of the final IMP, after incorporation of public comment, is anticipated to take place at the July Board meeting.

**Staff recommends that the Programs, Projects and Operations Subcommittee recommend to the Board of Directors that the draft Integrated Management Plan for the portion of the District within the Lower Platte River Basin be adopted by the District.**

**Papio-Missouri River Natural Resources District  
Board of Directors Meeting  
Suggested Resolutions/Recommendations  
May 8, 2014**

**\*Agenda Item 4 - Agenda**

BE IT RESOLVED that the agenda be adopted.

**\*Agenda Item 5 – Consent Agenda**

BE IT RESOLVED that the following resolutions on the consent agenda are hereby adopted.

Agenda Item 3.A.:

BE IT RESOLVED that the absence of the following Director from the May 8, 2014, Board of Directors Meeting is excused:

Tim Fowler

Agenda Item 7. A and B.

BE IT RESOLVED that the April 10, 2014 Papio-Missouri River NRD Board meeting minutes; and the April 9, 2014 Dakota County Rural Water Advisory Board meeting minutes are approved as printed.

**\*Agenda Item 10.A. – Programs, Projects and Operations Subcommittee**

BE IT RESOLVED that the minutes of the May 6, 2014, meeting of the Programs, Projects and Operations Subcommittee are accepted, incorporated in these minutes, and the following recommendation(s) of the Subcommittee are hereby adopted and approved.

1. Draft Voluntary Integrated Management Plan for the Lower Platte River – Recommendation that the draft Integrated Management Plan for the portion of the District within the Lower Platte River Basin be adopted by the District.
2. Interlocal Agreement with Nebraska Game & Parks for Operation and Maintenance of the Danish Alps State Recreation Area Project – Recommendation that the General Manager be authorized to execute the proposed Interlocal Agreement with the Nebraska Game and Parks Commission for the management, operation and maintenance of the Danish Alps State Recreation Area Project, subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.

**\*Agenda Item 10.B. – Finance, Expenditures and Legal Subcommittee**





**PAPIO-MISSOURI RIVER  
NATURAL  
RESOURCES  
DISTRICT**

8901 S. 154th Street  
Omaha, NE 68138-3621  
402-444-6222  
[www.papionrd.org](http://www.papionrd.org)

May <sup>9</sup>~~05~~, 2014

Brian Dunnigan P.E., Director  
Nebraska Department of Natural Resources  
P.O. Box 94676  
Lincoln NE 68509-4676

Director Dunnigan:

At the May 8 regular Board Meeting the Papio-Missouri River Natural Resources District (P-MRNRD) Board of Directors reached consensus on the opinion agreement between the P-MRNRD and the Department regarding 1) proposed goals and objectives of the voluntary Integrated Management Plan (IMP) for the P-MRNRD, 2) the proposed geographic area to be subject to controls, 3) the surface water and groundwater controls which are proposed in the voluntary IMP for adoption and implementation. We recommend the P-MRNRD and the Department schedule a joint hearing on the proposed voluntary IMP and proposed controls within forty-five days of mutual agreement by the Department and the P-MRNRD on items 1 through 3 listed above. Please confirm this agreement in writing.

The P-MRNRD Board of Directors recognizes and appreciates the Departments contribution in facilitating the voluntary IMP. We appreciate the efforts of the Department staff over the last year and a half working with our staff to draft the IMP. The P-MRNRD has enjoyed the good working relationship with the Department and hopes to continue in the future as we implement the voluntary IMP.

Sincerely,

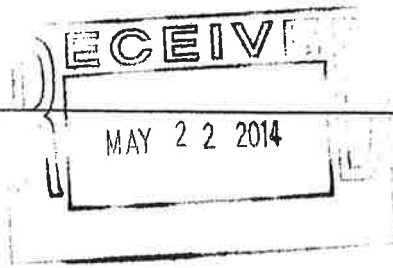
John Winkler  
General Manager  
Papio-Missouri River  
Natural Resources District

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Papio – Missouri River Natural Resource District Board of Directors  
Patrick Bonnet Fred Conley John Conley Tim Fowler Scott Japp David Klug  
Patrick Leahy Richard Tesar Jim Thompson Ron Woodle  
John Winkler, General Manager



Dave Heineman  
Governor



STATE OF NEBRASKA

DEPARTMENT OF NATURAL RESOURCES  
Brian P. Dunnigan, P.E.  
Director

May 20, 2014

IN REPLY TO:

Fred Conley, Board Chairperson  
Papio-Missouri River Natural Resources District  
8901 S. 154<sup>th</sup> Street  
Omaha, NE 68138

Dear Mr. Conley:

On May 19, 2014, the Department received your letter stating that an agreement regarding the voluntary integrated management plan (IMP) between the Papio-Missouri River Natural Resources District (District) and the Department of Natural Resources (Department) has been reached. This agreement includes the:

- 1) proposed goals and objectives of the voluntary IMP,
- 2) proposed geographic area to be subject to controls of the voluntary IMP, and
- 3) surface water and groundwater controls and incentive programs that are proposed in the voluntary IMP for adoption and implementation.

Enclosed please find a copy of the agreed-upon voluntary IMP. The Department mutually agrees with the District and will work with you in scheduling the public hearing on June 12, 2014, at 7:00 p.m. at the District office in Omaha.

The Department greatly appreciates the time taken by the District's Board of Directors, staff, and stakeholders throughout the IMP development process. We also look forward to a continued working relationship that ensures the goals and objectives of the IMP are reached.

Sincerely,

Brian P. Dunnigan, P.E.  
Director

Enclosure

cc: John Winkler, General Manager

## Memorandum

**To:** Program Projects and Operations Subcommittee  
**From:** Brian L. Henkel, Groundwater Management Engineer  
**Date:** July 8, 2014  
**Re:** Voluntary Integrated Management Plan Final Adoption

---

In November 2011 the District's Board of Directors voted to develop a voluntary Integrated Management Plan (IMP) for the portion of the District within the Lower Platte River Basin. A voluntary IMP is a proactive approach to the management of the water resources through cooperative planning with the Nebraska Department of Natural Resources (Department) that offers greater flexibility of management for both surface water and groundwater. Integrated management recognizes the interconnectedness of these waters and develops strategies to ensure a balance between water uses and water supplies for the long term. The District's IMP is for the area designated by the Department to have alluvial aquifers that are hydrologically connected to the Platte and Elkhorn Rivers and includes the portion of the District that contributes surface water runoff to the Platte and Elkhorn Rivers.

The Board adopted a set of proposed goals and objectives at their meeting on September 8, 2013. The set of goals and objectives along with action items formed the backbone of the draft IMP that was jointly agreed upon by the District and the Department in May 2014. A public hearing was held to collect testimony from residents of the District. The testimony was reviewed and it was determined that the following changes be made to the draft IMP:

- Revise the Stakeholder Advisory Committee based upon the documented attendance (This list only includes those attendees present at one or more meetings.).
- Revise the Stakeholder Advisory Committee list to provide greater detail about the affiliation of the individual members (As requested, the description of Tanna Wirtz was changed to Resident of Washington County).
- Refinements to the included map of the IMP area for clarification (On Figure 1, emphasized county boundaries and added a call-out box for the IMP area and on Figure 2, added the watershed boundaries and emphasized the surface water and groundwater control areas with a call-out box, modified the surface water control area to better match the definition).
- Corrected two spelling errors (McGuire on page 20 and statute on page 21)

The proposed changes are included in the final version of the Integrated Management Plan proposed for adoption. For clarification, the dates on page 5 will be filled in upon completion of the plan.

**Staff recommends that the Programs, Projects and Operations Subcommittee recommend to the Board of Directors that the Integrated Management Plan for the Lower Platte River Basin portion of the District be adopted.**

**Papio-Missouri River Natural Resources District  
Board of Directors Meeting  
Suggested Resolutions/Recommendations  
July 10, 2014**

**\*Agenda Item 4 - Agenda**

BE IT RESOLVED that the agenda be adopted.

**\*Agenda Item 5 – Consent Agenda**

BE IT RESOLVED that the following resolutions on the consent agenda are hereby adopted.

**Agenda Item 3.A.:**

BE IT RESOLVED that the absence of the following Director(s) from the July 10, 2014, Board of Directors Meeting is excused:

None to date.

**Agenda Item 7. A., and 7.B.:**

BE IT RESOLVED that the June 12, 2014 Papio-Missouri River NRD Board meeting minutes and the June 11, 2014 Dakota County Rural Water Advisory Board meeting minutes are approved as printed.

**\*Agenda Item 10.A. – Programs, Projects and Operations Subcommittee**

BE IT RESOLVED that the minutes of the July 8, 2014, meeting of the Programs, Projects and Operations Subcommittee are accepted, incorporated in these minutes, and the following recommendation(s) of the Subcommittee are hereby adopted and approved.

1. Proposed Easements for the North Shore Phase 3 Development (SID 292) on WP-5 Project Property – Recommendation that the General Manager be authorized to execute the Permanent Storm Sewer and Drainage Easement, Temporary Construction Easement, and the Permanent Sanitary Sewer Easements with SID 292 on the WP-5 project property, as presented to the Subcommittee, subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.
2. Nebraska Environmental Trust (NET) Grant Application for Installation of Solar Panel Array and an Information and Education Component at the P-MRNRD

Headquarters – Recommendation that the General Manager be authorized to submit a \$110,000 project request to the Nebraska Environmental Trust at a 75% NET (\$82,500.00), 25% NRD (\$27,500.00) cost share for the installation of a solar array and informational kiosk at the NRD Headquarters.

3. Candlewood Lake Dam Drawdown Repairs Project Bid Opening - Recommendation that the General Manager be authorized to execute a contract with Eriksen Construction, for the construction of the Candlewood Lake Dam Drawdown Repairs Project, as presented to the Subcommittee, in a not-to-exceed amount of \$52,300, subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.
4. PL-566 Site 15B Interlocal Agreement with SID 564 (Grove Ridge) – Recommendation that the General Manager be authorized to execute the proposed Interlocal Cooperative Agreement with SID 564 of Douglas County (Grove Ridge), for Pappio Watershed Structure D-15B, as presented to the Subcommittee, subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.
5. Thompson Creek Interlocal Agreement with City of La Vista – Recommendation that the General Manager be authorized to execute the proposed Interlocal Cooperative Agreement with the City of La Vista, Nebraska, for the Thompson Creek Levee Improvement Project, as presented to the Subcommittee, subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.
6. Thompson Creek Levee Improvement Project Relocation Agreement with Omaha Public Power District (OPPD) – Recommendation that the General Manager be authorized to execute the proposed Agreement with Omaha Public Power District for relocation of OPPD facilities impacted by the Thompson Creek Levee Improvement Project, as presented to the Subcommittee, subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.
7. Lower Platte River Weed Management Program Amendment to the Interlocal Agreement – Recommendation that the General Manager be authorized to execute the Amended Interlocal Cooperation Agreement for the Lower Platte River Phragmites Management Program, as presented to the Subcommittee, and subject to changes deemed necessary by the General Manager and approved as to form by District Legal Counsel.

BE IT RESOLVED that the following amended recommendation of the Subcommittee are hereby adopted and approved as amended.

8. Pigeon Creek Levee Emergency Repair – Recommendation that the General Manager be authorized to use the Informal Competitive Bidding procedures provided by District Policy 15.6.B for the acquisition of emergency services of engineers, contractors, and vendors of other property or services, not limited to the \$50,000 policy threshold, as the General Manager determines necessary to repair the Pigeon Creek Levee breach that occurred in the Elk/Pigeon Creek Improvement Area in Dakota County and take necessary steps to effect those repairs. In addition to waiving the \$50,000 policy limitation of District Policy 15.6.B, the Board hereby

waives the requirements of bid and performance bonds normally required by District Policies 15.7 and 15.8 for those emergency services obtained for the repair of the Pigeon Creek Levee breach.

9. West Douglas County Trail System Supplemental Agreement for Professional Engineering Services with Ehrhart, Griffin & Associates – Recommendation that the General Manager be authorized to execute a Supplemental Agreement between the District and Ehrhart, Griffin & Associates for Engineering Services for the Western Douglas County Trail Project, Phase 1 & 2, for an increase in costs not-to-exceed \$35,520.59.
10. Final Adoption of the Integrated Management Plan for the Lower Platte River – Recommendation that the Integrated Management Plan for the Lower Platte River Basin portion of the District be adopted, as presented to the Subcommittee, and incorporated into the District's Policy Manual.

\*Agenda Item 10.B. – Finance, Expenditures and Legal Subcommittee

BE IT RESOLVED that the minutes of the July 8, 2014, meeting of the Finance, Expenditures and Legal Subcommittee are accepted, incorporated in these minutes, and the following recommendations of the Subcommittee are hereby adopted and approved.

1. FY 2015 Budget – Draft 1 – No action was taken by the Subcommittee.
2. Proposed Increase to the Thurston County Rural Water Rate Schedule – Recommendation that the General Manager be authorized to set a new increased rate schedule for the Thurston County Rural Water System, to be effective September 1, 2014, as presented to the Subcommittee.

BE IT RESOLVED that the following amended recommendations of the Subcommittee are hereby adopted and approved as amended.

3. Dam Site 15A Land Acquisition –
  - a.) Recommendation that the General Manager be authorized to execute a purchase agreement for Papio Dam Site 15A Project Tract 1 in the amount of \$144,285 for 9.619 acres of land; and authorized to execute a purchase agreement for Papio Dam Site 15A Project Tract 7 in the amount of \$140,736 for 8.796 acres of land; and authorized to execute a purchase agreement for Papio Dam Site 15A Project Tract 13-15 in the amount of \$5,490,885 for 129.317 acres of land, such purchase agreements to contain provisions for the owners to retain leases over such lands for the 2014 crop year (expiring on or before November 15, 2014) and such other terms and conditions as the General Manager deems necessary and Legal Counsel approves as to form.

And:

Negotiations for Dam Site 15A Tracts 5 and 6:



July 16, 2014

Director Brian Dunnigan, P.E.  
Nebraska Department of Natural Resources  
301 Centennial Mall South, 4th Floor  
P.O. Box 94676  
Lincoln, Nebraska 68509-4676

RE: Voluntary Integrated Management Plan

Director Dunnigan,

On July 12, 2014 the Papio-Missouri River Natural Resources District (District) voted to adopt the final version of the voluntary Integrated Management Plan (IMP) for the Lower Platte River portion of the District. The final version of the IMP incorporated some minor changes to the draft IMP based on testimony received at the June 12, 2014 public hearing and review of that testimony by District and Department staff. The revisions did not change the goals, objectives, surface water control, or groundwater control, and did not include any geographic area not identified in the notice of the hearing as presented in the draft version.

This letter is to inform the Department of the Board's adoption of the IMP and to propose that the effective date for the IMP be set as August 31, 2014. If the Department is in agreement with the final version of the IMP and agrees to the effective date, please provide a letter stating such to the District.

The District appreciates the Department's collaboration on this planning process and the Department's contributions to the IMP. The District looks forward to continued collaboration with the Department in the implementation of this plan and the sustainable management of these important water resources.

Highest Regards,

John Winkler  
General Manager  
Papio-Missouri River Natural Resources District

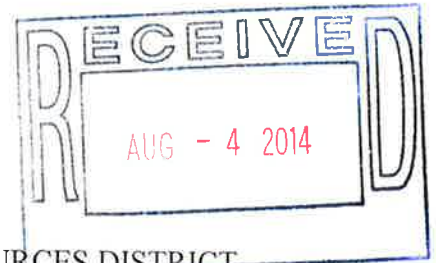
Cc: Marlin Petermann & Brian Henkel, Papio-Missouri River NRD

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Papio – Missouri River Natural Resource District Board of Directors  
Patrick Bonnet Fred Conley John Conley Tim Fowler Scott Japp David Klug  
Patrick Leahy Richard Tesar Jim Thompson Ron Woodie  
John Winkler, General Manager



STATE OF NEBRASKA  
DEPARTMENT OF NATURAL RESOURCES



ORDER ADOPTING PAPIO-MISSOURI RIVER NATURAL RESOURCES DISTRICT  
INTEGRATED MANAGEMENT PLAN AND ASSOCIATED SURFACE WATER  
CONTROL

Background

1. On November 15, 2011, the Papio-Missouri River Natural Resources District (District) submitted a letter of intent to develop a voluntary Integrated Management Plan (IMP) to the Nebraska Department of Natural Resources (Department).
2. The Department and the District consulted on the development of the voluntary IMP with a group of stakeholders. The stakeholder group consisted of the statutorily required and other entities that were identified by the Department and the District to be included in the group. Through this process of consultation, the Department and the District jointly developed a voluntary IMP in accordance with the *Ground Water Management and Protection Act* (the Act), particularly, *Neb. Rev. Stat.* §§ 46-715, 46-716, 46-717, and 46-718.
3. The Department and the District reached agreement on (a) the proposed goals and objectives of the voluntary IMP, (b) the proposed geographic area to be subject to the controls of the voluntary IMP, and (c) the surface water controls and groundwater controls that are proposed for adoption and implementation of the voluntary IMP.
4. On June 12, 2014, pursuant to notices duly published in accordance with *Neb. Rev. Stat.* § 46-743, the Department and the District jointly held a public hearing in Omaha, Nebraska, on the proposed voluntary IMP.
5. Subsequent to the hearing on June 12, 2014, the Department and the District reviewed the testimony and jointly agreed to adopt and implement the proposed IMP with only minor revisions. Those revisions did not consist of any modifications to the goals and objectives of the voluntary IMP, or the surface water controls and groundwater controls proposed for adoption and implementation in the IMP, and did not include any geographic area that was not identified in the notice of hearing as presented in the draft version of the IMP.
6. On July 10, 2014, the District adopted the proposed IMP and affirmed the use of groundwater controls necessary for implementing the IMP.
7. On July 24, 2014, the Department sent the District a letter agreeing to adopt the proposed IMP and surface water controls.

## Control Adopted

1. The surface water control included in the IMP is as follows:

- The Department will establish an annual limit on the expansion of surface water-irrigated acres. The limit on the expansion of surface water-irrigated acres shall be a maximum of one-third of the amount the District will allow for the expansion of groundwater-irrigated acres. The Department will utilize the number of additional groundwater irrigated acres in place in the IMP area as of January 1 of each year for determining the number of additional surface water irrigated acres for each calendar year. The limit established on the expansion of surface water irrigated acres is for agricultural production land irrigated from a new surface water appropriation and does not include other types of irrigation use, municipal use, or industrial use. In addition, should the District issue a moratorium on any increase in groundwater-irrigated acres, the Department will issue a similar moratorium to limit development of additional acres for surface water irrigation.

## Order

It is therefore ORDERED that the voluntary integrated management plan for the Papio-Missouri River Natural Resources District and the surface water controls in the plan are hereby adopted by the Department and will become effective on August 31, 2014.

DEPARTMENT OF NATURAL RESOURCES

August 1, 2014

  
Brian P. Dunnigan, P.E., Director

Any person with sufficient legal interest who has been or may be substantially affected by this Order may request a contested case hearing in accordance with the *Nebraska Administrative Procedures Act* (*Neb. Rev. Stat. §§ 84-901 et. seq.*) and the Department's *Rules of Practice and Procedure* (*Title 454 Neb. Admin. Code Chapter 007*). The request must be received by the Department at its Lincoln office (Nebraska State Office Building, 301 Centennial Mall South, 4<sup>th</sup> Floor, Lincoln, NE 68509-4676) within 30 days of the date of this Order and be accompanied by a filing fee of \$10.00.

On August 1, 2014, a copy of this Order was posted on the Department's website and mailed to John Winkler, General Manager, Papio-Missouri River Natural Resources District, 8901 S. 154<sup>th</sup> Street, Omaha, NE 68138; and to the Department of Natural Resources field offices.

**APPENDIX B**  
**P-MRNRD Accomplishments to IMP Goals and Objectives**

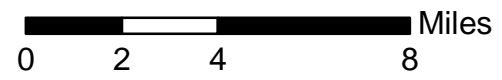
Action Item	P-MRNRD	NDNR	Proposed 2015 Schedule	EOY Implementation Status	Comment
Action Item 1.1.1 Review and evaluate the P-MRNRD's Groundwater Management Plan relative to the goals and objectives of the IMP. (P-MRNRD)	X		July - Review and prepare new scope; Aug. - Oct. - Select consultant; Jan. - March 2016 - Annual Report Documentation	Olsson Associates (OA) has been contracted to update GWMP.	Stakeholder meeting will likely take place in July - Dec 2016 with final update in 2017.
Action Item 1.1.2 Evaluate the need for a ranking system for new groundwater irrigation wells or expanded groundwater irrigated acres. (P-MRNRD)	X		Complete as part of 1.1.1 in 2016	Evaluation will take place as part of GWMP update.	
Action Item 1.1.3 Evaluate the need to require proposed new groundwater well field expansions and new large groundwater uses to perform an impact analysis. (P-MRNRD)	X		Complete as part of 1.1.1 in 2016	Evaluation will take place as part of GWMP update.	
Action Item 1.1.4 Assess the need to further study the Lower Platte aquifer properties, extents, and connectivity to surface water. (Both)	X	X	Oct. - Complete ENWRA Report; Jan. - March 2016 - Annual Report Documentation	ENWRA report complete, <a href="http://enwra.org/aem%20data%20download.html">http://enwra.org/aem%20data%20download.html</a> .	P-MRNRD study with USGS to monitor GW elev b/w Leshara and Waterloo. IDEP and WSF Funding
Action Item 1.1.5 Assess the need for additional revenue sources to be used to fund programs and projects resulting from this IMP. (P-MRNRD)	X		July - Complete this review and if appropriate include in budget; Jan. - March 2016 - Annual Report Documentation	Funding opportunities review completed by OA June 2015. Applied for WSF and IDEP funding.	
Action Item 1.1.6 Identify and study opportunities for the development of transfers, variances, water banking, and other actions of water management to potentially be used in the IMP Area. (Both)	X	X	Oct - Document involvement of LP Basin Plan	Opportunities being evaluated as part of LPR Basin Plan	Draft LPR Basin Plan Report has been delayed
Action Item 1.2.1 Provide financial and administrative support to weed management activities in river channels. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	Completed 2015 aerial and ground spraying with LPR Weed Mngt Area	New aerial spaying contractor and interlocal agreement amendment in 2016
Action Item 1.2.2 Encourage removal of invasive species to improve channel conveyance. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	""	""
Action Item 1.3.1 Evaluate the potential for conjunctive management programs or project opportunities to protect existing users or mitigate new uses such as water rights leases, interference agreements, augmentation projects, conjunctive use management, or use retirement. (Both)	X		July - Oct - Complete Evaluation; Jan. - March 2016 - Annual Report Documentation	Some conjunctive management opportunities being evaluated as part of LPR Basin Plan	Draft LPR Basin Plan Report has been delayed. Future study with LPSNRD, LPNNRD, MUD and LWS
Action Item 2.1.1 Identify important data components to monitor in order to ensure the best available datasets are used in the NDNR's annual evaluation. (Both)	X	X	August Meeting - Review; Jan. - March 2016 - Annual Report Documentation	Data collection examination completed by OA in June 2015.	Data sets are being compiled and mapped for GWMP update (1.1.1). P-MRNRD study with USGS to monitor GW elev b/w Leshara and Waterloo.
Action Item 2.1.2 Estimate consumptive water use utilizing the best available data and analysis tools. (Both)	X	X	June - Complete evaluation; July - Oct - Refine; Jan. - March 2016 - Annual Report Documentation	Options and protocols report completed by OA in June 2015.	Need adequate land use assessment to baseline updated water balance calculations
Action Item 2.1.3 Assess the need for additional monitoring and ensure information on land use changes are evaluated with respect to water use utilizing the best available data and tools. (Both)	X	X	June - Complete evaluation; July - Oct - Refine, complete acre certification in GIS; Jan. - March 2016 - Annual Report Documentation	Irrigated acre certification layers updated.	Continue certification with landowners. Need adequate land use assessment to baseline updated water balance calculations
Action Item 2.1.4 Continue to monitor changes in streamflow and groundwater levels. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Spring 2015 GW level maps completed (attached).	P-MRNRD study with USGS to monitor GW elev b/w Leshara and Waterloo.
Action Item 2.1.5 Continue to gather and analyze hydrogeologic data. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation and ENWRA info	ENWRA report complete, <a href="http://enwra.org/aem%20data%20download.html">http://enwra.org/aem%20data%20download.html</a> .	No current plans for AEM or new boreholes in IMP area.
Action Item 2.2.1 Develop or maintain a comprehensive spatial/tabular water inventory database that includes measurements or estimates of components of the water budget. (Both)	X	X	July - Develop initial database; Oct - track and enter data; Jan. - March 2016 - Annual Report Documentation	Data and database collected from Oct. 13, 2013 Water Balance report by B&C.	Need adequate land use assessment to baseline updated water balance calculations

Action Item	P-MRNRD	NDNR	Proposed 2015 Schedule	EOY Implementation Status	Comment
Action Item 2.2.2 Develop or maintain science-based protocols for estimating unmeasured water uses. (Both)	X	X	July - complete evaluation; Oct. - complete recommendations; Jan. - March 2016 - Annual Report Documentation	Options and protocols report completed by OA in June 2015.	Need adequate land use assessment to baseline updated water balance calculations
Action Item 2.2.3 Establish a system to better monitor and evaluate changes in surface water and groundwater supplies and uses. (Both)	X	X	July - complete evaluation; Oct. - complete recommendations; Jan. - March 2016 - Annual Report Documentation	Options and protocols report completed by OA in June 2015.	Need adequate land use assessment to baseline updated water balance calculations
Action Item 2.2.4 Track variability in water use and supply by regularly evaluating data from existing surface water, groundwater, and weather monitoring networks. (Both)	X	X	July - complete evaluation; Oct. - complete recommendations; Jan. - March 2016 - Annual Report Documentation	Options and protocols report completed by OA in June 2015. Further data gaps are being assessed as part of GWMP update (1.1.1)	
Action Item 2.2.5 Recommend changes to the Groundwater Management Plan as necessary. (P-MRNRD)	X		Complete as part of 1.1.1 in 2016/2017	Olsson Associates has been contracted to update GWMP.	Stakeholder meeting will likely take place in July - Dec 2016 with final update in 2017.
Action Item 2.3.1 Obtain short- and long-term water use projections from municipalities. (Both)	X	X	Nov - Hold meeting and collect data; Jan. - March 2016 - Annual Report Documentation	No meeting held. Annual municipal water use for 2014 and 2015 collected in February 2016.	
Action Item 2.3.2 Develop online water use form for reporting annual water use. (Both)	X	X	July - Develop initial webpage; Nov. - hold meeting and collect data; Jan. - March 2016 - Annual Report Documentation	Not completed at this point. Still evaluating need as we complete GWMP update.	
Action Item 2.3.3 Investigate the need for metering for annual reporting of irrigation and other large water uses. (Both)	X	X	Oct - complete evaluation; Jan. - March 2016 - Annual Report Documentation	Update well inventory as part of irrigated acre certification. No evaluation of metering at this time.	
Action Item 2.3.4 Evaluate the need to expand existing or develop new rural water systems (Improvement Project Areas). (P-MRNRD)	X		Oct - complete evaluation; Jan. - March 2016 - Annual Report Documentation	Further analysis on this will be competed as part of the GWMP update (1.1.1).	
Action Item 2.3.5 Develop estimates of water use from private, domestic, and other unmetered wells. (P-MRNRD)	X		See 2.2.2	Options and protocols report completed by OA in June 2015.	
Action Item 3.1.1 Continue to use existing and develop additional information and education programs that promote wise water use and conservation. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	No meeting held in 2015. Continued urban stormwater promotion.	Ideas to promote: lawn irrigation management, ag irrigation management (NRCS EQUIP), Test your well event, enhance soil conditions.
Action Item 3.1.2 Evaluate the need for additional cost-share programs or projects to promote wise water use and conservation. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	No update.	Work with LPNRRD and NRCS on irrigation efficiency, soil moisture equipment, reporting.
Action Item 3.1.3 Collaborate with schools and other agencies to develop curriculum on water supplies and water conservation measures for use in classrooms. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	School presentations provided by P-MRNRD education staff.	
Action Item 3.2.1 Coordinate with public water systems to develop or expand educational materials and programs on water supplies, water quality, and best conservation practices. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	MUD water conservation: <a href="http://www.mudomaha.com/water">http://www.mudomaha.com/water</a> .	Need to host meeting.
Action Item 3.2.2 Continue to coordinate with cities, counties, and others as they develop long-term planning activities. (P-MRNRD)	X		Nov - hold meeting; Jan. - March 2016 - Annual Report Documentation	No update.	GWMP update stakeholder meetings will involve local gov planning
Action Item 3.2.3 Continue to coordinate with industries, cities, and agricultural producers to promote the use of best management practices for stormwater management. (P-MRNRD)	X		Nov - hold meeting; Jan. - March 2016 - Annual Report Documentation	No update.	GWMP update stakeholder meetings will discuss BMPs

Action Item	P-MRNRD	NDNR	Proposed 2015 Schedule	EOY Implementation Status	Comment
Action Item 3.2.4 Continue to coordinate with cities, counties, and others to encourage water education and conservation. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	P-MRNRD education programs offered. Need to coordinate.	Need to host meeting.
Action Item 3.2.5 Evaluate the potential for programs or projects that support the use of best management practices related to agricultural crop water management. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	No update.	Work with LPNNRD and NRCS on irrigation efficiency, soil moisture equipment, reporting.
Action Item 3.2.6 Evaluate implementing urban cost-share incentive programs to encourage indoor and outdoor water conserving technology or landscaping. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	P-MRNRD has urban stormwater program.	Work with more cities and counties to best implement new development standards.
Action Item 3.3.1 Evaluate the positive and negative effects of capturing and using waste water. (P-MRNRD)	X		Work with Eric and Lori?	No update.	Need to host meeting.
Action Item 3.3.2 Cooperate with public water systems to identify potential applications for reuse of treated waste water. (P-MRNRD)	X		Work with Eric and Lori?	No update.	Need to host meeting.
Action Item 4.1.1 Cooperate on water management studies and planning with the Lower Platte River Basin Water Management Plan Coalition. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Participated in all meetings and workshops	Draft LPR Basin Plan Report has been delayed
Action Item 4.1.2 Continue to support the efforts and initiatives of the Eastern Nebraska Water Resources Assessment. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Provided cost-share. ENWRA report complete, <a href="http://enwra.org/aem%20data%20download.html">http://enwra.org/aem%20data%20download.html</a> .	
Action Item 4.2.1 Review and analyze existing studies of water storage opportunities in the Lower Platte River Basin and conduct additional multi-agency studies as appropriate. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Opportunities being evaluated as part of LPR Basin Plan	Draft LPR Basin Plan Report has been delayed
Action Item 4.2.2 Evaluate the potential for conjunctive management programs or project opportunities to mitigate new uses such as water rights leases, interference agreements, augmentation projects, conjunctive use management, or use retirement. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Some conjunctive management opportunities being evaluated as part of LPR Basin Plan	Draft LPR Basin Plan Report has been delayed. Future study with LPSNRD, LPNNRD, MUD and LWS
Action Item 4.2.3 Assess federal or statewide funding opportunities to further the goals and objectives of the IMP. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Funding opportunities review completed by OA June 2015. Applied for WSF and IDEP funding.	
Action Item 4.3.1 Coordinate with other entities to identify and study opportunities for the development of transfers, variances, water banking, and other actions of water management to potentially be used across the entire Platte River Basin. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	Opportunities being evaluated as part of LPR Basin Plan	Draft LPR Basin Plan Report has been delayed
Action Item 4.4.1 Work with the Platte River Recovery and Implementation Program on water management planning activities, as necessary. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	No update.	
Action Item 4.5.1 Review and assess the benefits from instream flow protection. (Both)	X	X	Jan. - March 2016 - Annual Report Documentation	No update.	
GW Control - Establish a limit on the expansion of groundwater-irrigated acres. (P-MRNRD)	X		Jan. - March 2016 - Annual Report Documentation	Enacted as of November 11, 2014	
SW Control - Establish a limit on the expansion of surface water-irrigated acres. (NDNR)		X	Jan. - March 2016 - Annual Report Documentation	Enacted as of August 1, 2014	
Other - Monitoring and Reporting Annually (P-MRNRD)	X				

**APPENDIX C**  
**Supplemental Figures and Evaluation Reports**

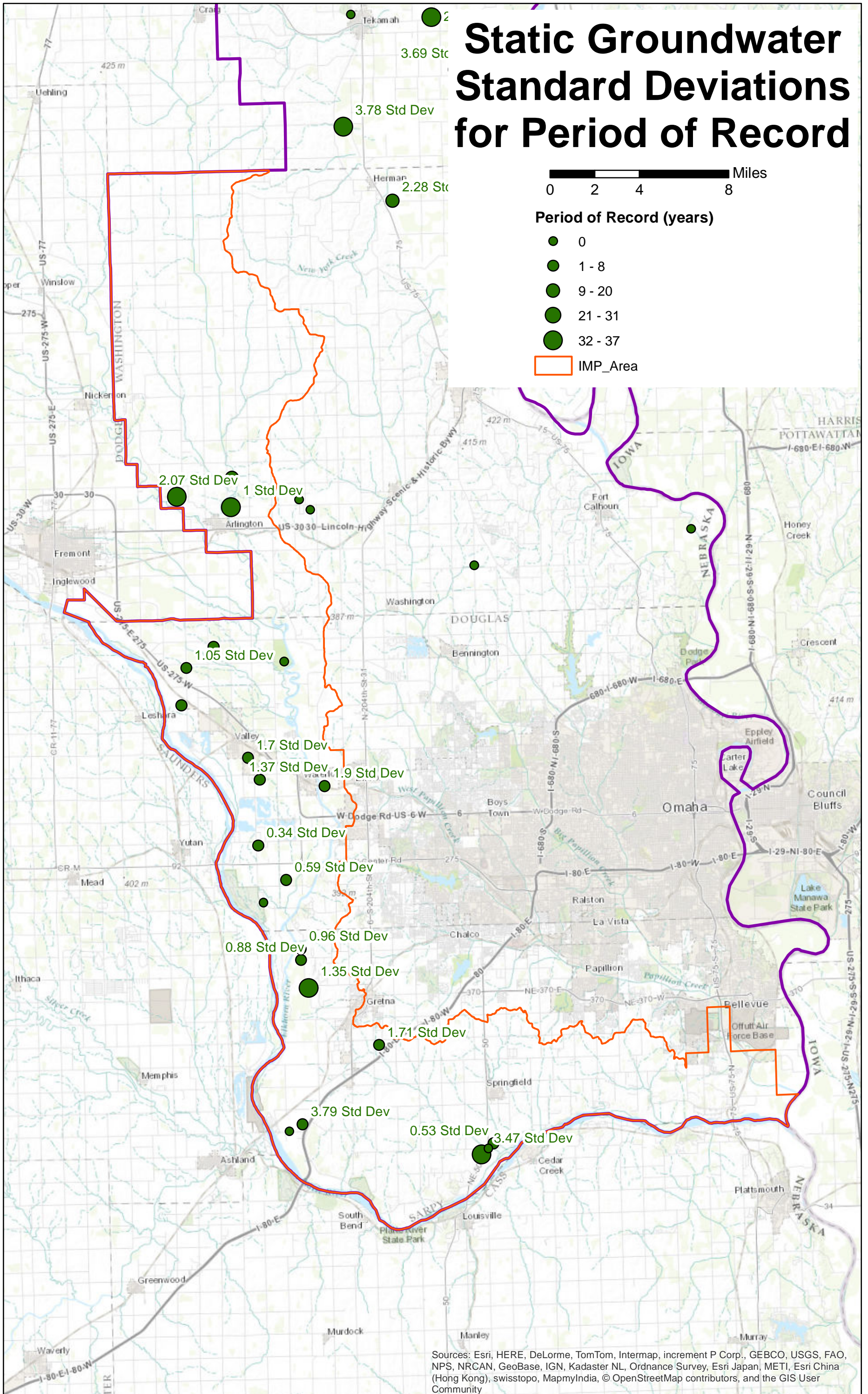
# Static Groundwater Standard Deviations for Period of Record



## Period of Record (years)

- 0
- 1 - 8
- 9 - 20
- 21 - 31
- 32 - 37

IMP\_Area



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

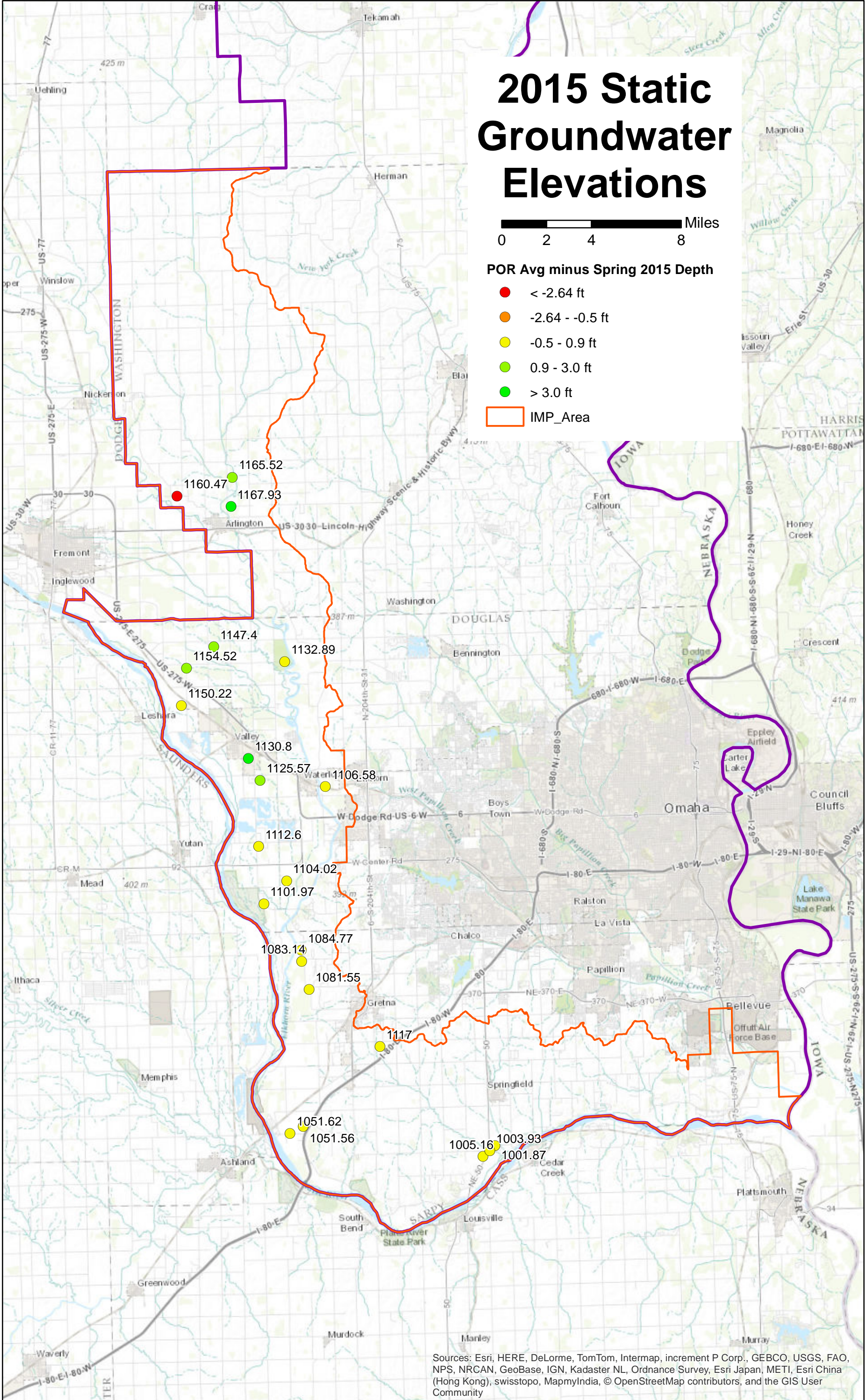


# 2015 Static Groundwater Elevations



POR Avg minus Spring 2015 Depth

- < -2.64 ft
- -2.64 - -0.5 ft
- -0.5 - 0.9 ft
- 0.9 - 3.0 ft
- > 3.0 ft
- IMP\_Area



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

**Action Item:**

**Review and Evaluation of Current Groundwater Management Plan**

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PRELIMINARY DRAFT

## Background and Authority for Groundwater Programs

As cited in the Nebraska Groundwater Management and Protection Act (46-702), “the legislature recognizes the need to provide for orderly management systems in areas where management of groundwater is necessary to achieve locally and regionally determined groundwater management objectives...” In order to comply with legislature, the Papio-Missouri River Natural Resources District (PMRNRD) is exploring the option of adopting an update of their Groundwater Management Plan (GWMP). The original PMRNRD GWMP states “groundwater quantity is not now nor will it be a problem in the foreseeable future” (PMRNRD 1994). However, during the years since the last GWMP revision, the PMRNRD has acquired or developed significant data and information about the groundwater resources in the district, increasing the need to manage groundwater quality and interconnected groundwater and surface water. For this reason, the PMRNRD is considering changes to their GWMP which address the issues of groundwater quantity and quality across the district.

## Development of Groundwater Management Plan as Required by Law

Per Nebraska Groundwater Management and Protection Act (46-709), “each district shall maintain a Groundwater Management Plan based upon the best available information. This plan should include, but not be limited to:

- Groundwater supplies within the district including transmissivity, saturated thickness maps, and other groundwater reservoir information, if available;
- Local recharge characteristics and rates from any sources, if available;
- Average annual precipitation and the variations within the district;
- Crop water needs within the district;
- Current groundwater data-collection programs;
- Past, present, and potential groundwater use within the district;
- Groundwater quality concerns within the district; including the levels and sources of groundwater contamination within the district, groundwater quality goals, long-term solutions necessary to prevent the levels of groundwater contaminants from becoming too high and to reduce high levels sufficiently to eliminate health hazards, and practices recommended to stabilize, reduce, and prevent the occurrence, increase, or spread of groundwater contamination.
- Proposed water conservation and supply augmentation programs for the district;
- The availability of supplemental water supplies, including the opportunity for groundwater recharge;
- The opportunity to integrate and coordinate the use of water from different sources of supply;
- Groundwater management objectives, including a proposed groundwater reservoir life goal for the district. For management plans adopted or revised after July 19, 1996, the groundwater management objectives may include any proposed integrated management objectives for hydrologically connected groundwater and surface water supplies but a management plan does not have to be revised prior to the adoption or implementation of an integrated management plan pursuant to section 46-718 or 46-719;
- Existing subirrigation uses within the district;
- The relative economic value of different uses of groundwater proposed or existing within the district; and
- The geographic and stratigraphic boundaries of any proposed management area.

Source: Laws 1982, LB 375, § 3; Laws 1983, LB 378, § 3; Laws 1984, LB 1106, § 37; R.S. 1943, (1993), § 46-673.01; Laws 1996, LB 108, § 18; Laws 2000, LB 900, § 191; Laws 2003, LB 619, § 12; R.S. Supp., 2003, § 46-656.12; Laws 2004, LB 962, § 49. Effective date: July 16, 2004.

## Programs Currently in GWMP

The current PMRNRD GWMP (PMRNRD 1994) includes management by the PMRNRD through the following programs.

- Static water level monitoring program
- Groundwater quality monitoring program
- Enforcement of Nebraska Chemigation Act
- Well abandonment cost share program

In addition to these programs, the GWMP states an objective for the district is to “Establish management, control, or special protection areas in the District to address specific problems of groundwater quality/quantity, should the data collected indicate that the groundwater reservoir life goal cannot be met”. This objective could be accomplished through the establishment of groundwater management areas. A description of the potential development of groundwater management areas can be seen below.

## Suggested Programs to Include in GWMP

### Management Areas

The Nebraska Groundwater Management and Protection Act (46-703(3)) states, “Natural resources districts already have significant authority to regulate activities which contribute to declines in groundwater levels and to nonpoint source contamination of groundwater and are the preferred entities to regulate, through groundwater management areas, groundwater related activities which are contributing to or are in the reasonable foreseeable future, likely to contribute to conflicts between groundwater users and surface water appropriators or to water supply shortages in fully appropriated or overappropriated river basins, subbasins, or reaches”. Additionally, “a natural resources district may establish a groundwater management area in accordance with this section to accomplish any one or more of the following objectives: (a) Protection of groundwater quantity; (b) protection of groundwater quality; or (c) prevention or resolution of conflicts between users of groundwater and appropriators of surface water, which groundwater and surface water are hydrologically connected” (46-712). Groundwater management areas shall include an evaluation of both water quality and water quantity.

One potential mechanism for dividing the District into groundwater management areas includes that executed by the Lower Platte South NRD in their GWMP (LPSNRD 1995). The LPSNRD first separated their District into one of three subareas based on groundwater reservoirs.

- Groundwater Reservoirs (GWR) – represents areas which have access to productive and good quality groundwater source.
- Remaining Area (RA) – represents areas which do not have access to a productive groundwater source.
- Community Water System Protection Areas (CWSPA) – well head protection areas.

These subareas are then designated as Phases (Phase I, II, or III). These Phases represent increasing regulation on the basis of groundwater quality and quantity. Triggers for groundwater quantity are established by individual Natural Resources Districts. Triggers for quality are based on Department of Environmental Quality guidelines.

### Well Permitting

Neighboring NRDs have established well permitting on the basis of proximity to groundwater reservoir and proposed pumping rate. For instance, the LPSNRD requires different permitting requirements depending

on whether the well will be constructed in a GWR or RA, and depending on the pumping rate. For instance, the LPSNRD requires a Class I Permit for wells constructed in a GWR which will pump between 50 and 1,000 gallons per minute (gpm). A Class II Permit is required for a well constructed in a GWR which will pump greater than 1000 gpm. A Class III Permit is required for a well constructed in the RA and is designed to pump between 20 and 250 gpm. A Class IV Permit is needed which constructing a well in the RA which will pump greater than 250 gpm (LPSNRD 1995). Additionally, the LPSNRD requires an aquifer test be conducted before approving a Class II or IV Permit. The purpose of the aquifer test is to assess the effect the new well may have on neighboring wells and the aquifer.

### Water Banking

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The PMRNRD can explore the possibility of developing a water banking program in their district. Existing water banks in Nebraska include the Central Platte NRD Water Banking Program, Lower Loup NRD Irrigated Acres Transfer Program, and the Central Nebraska Public Power and Irrigation District (CNPPID) Delivery Location Transfer Program. The PMRNRD can use the existing water banks to help develop their own water banking program. Additionally, the water banking program should be consistent with the goals and objectives of the Lower Platte River Basin Coalition Water Management Plan.

### Current Policies Not Included in GWMP

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The following bullets are management areas presently included in the PMRNRD policies. These policies could be added to future GWMP updates.

- Improper Irrigation Runoff.
- Variances.

### Additional Management Actions to Consider

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- Acre Certification.
- Fertilizer Meters or other appropriate methods for fertilizer application rate documentation.
- Well metering using a phased approach based on water level triggers.
- Irrigation Management.
- Cost-share programs for metering or instrumentation.
- Transfer of Groundwater.

## Resources for Use in Development of GWMP

Multiple geological/hydrogeological resources have been developed since the PMRNRD GWMP was last revised. A description of these resources can be seen below. All resources listed, but not limited to, can potentially be used to aid in the development of the GWMP.

- Eastern Nebraska Water Resources Assessment (ENWRA)
- Pappio-Missouri River Natural Resources District Voluntary Integrated Management Plan
- Hydrogeologic Assessment for Potential Development of Groundwater Modeling Tools in the Lower Platte River and Missouri River Tributary Basins
- Three Geologic Cross Sections Across Portions of Eastern Nebraska Showing Quaternary Lithologic Units and Stratigraphy of Uppermost Bedrock (UNL-CSD 2012)
- Lower Platte River Basin Coalition
- Integrated Network of Scientific Information & GeoHydrologic Tools (INSIGHT)
- USGS Water Quality Monitoring Data
- PMRNRD Groundwater Level Data

- Ongoing Groundwater Modeling, including the USGS farm process model and the NDNR’s Missouri Tributaries model

## Approval of GWMP

The Nebraska Groundwater Management and Protection Act (46-711) states that the “Director of Natural Resources shall review any Groundwater Management Plan or plan modification submitted by a district to ensure that the best available studies, data, and information, whether previously existing or newly initiated, were utilized and considered and that such plan is supported by and is a reasonable application of such information.” The director may need to consult the Department of Environmental Quality, if the GWMP proposes management areas on the basis of protecting water quality. The director has 90 days to review the proposed plan, and report back to the district with his/her approval or disapproval. Once the GWMP has been approved by the director, the district may proceed to schedule a public hearing.

Source: Laws 1982, LB 375, § 5; Laws 1986, LB 894, § 27; Laws 1993, LB 3, § 12; R.S. 1943, (1993), § 46-673.03; Laws 1996, LB 108, § 20; Laws 2000, LB 900, § 192; Supp., 2002, § 46-656.14; Laws 2004, LB 962, § 51. Effective date: July 16, 2004.

## Stakeholder and Public Involvement

The Nebraska Groundwater Management and Protection Act (46-710) states that during the development of a GWMP, the district can “actively solicit public comments and opinions and shall utilize and draw upon existing research, data, studies, or any other information which has been compiled by or is in the possession of state or federal agencies, natural resources districts, or any other subdivision of the state. State agencies, districts, and other subdivisions shall furnish information or data upon the request of any district preparing or modifying such a plan.” One way to accomplish this is through the solicitation of a Stakeholders Advisory Committee. Stakeholder Advisory Committees can be used to gain insights about the water issues facing the PMRNRD, and also to facilitate communication between the PMRNRD and the DNR and other state/federal agencies.

As stated in the Nebraska Groundwater Management and Protection Act (46-712), if the PMRNRD proposed groundwater management areas, the “district shall fix a time and place for a public hearing to consider the management plan information supplied by the director and to hear any other evidence”. The district then has 90 days to determine if the groundwater management area shall be designated. Additionally public hearings may be needed in the future if the district proposes changes to the controls initially established for the groundwater management area, or the geographic boundaries of the area.

Source: Laws 1982, LB 375, § 4; R.S. 1943, (1993), § 46-673.02; Laws 1996, LB 108, § 19; R.S. 1943, (1998), § 46-656.13; Laws 2004, LB 962, § 50. Effective date: July 16, 2004. Laws 1982, LB 375, § 7; Laws 1986, LB 894, § 28; Laws 1991, LB 51, § 2; Laws 1993, LB 3, § 13; R.S. 1943, (1993), § 46-673.05; Laws 1996, LB 108, § 25; Laws 1997, LB 188, § 1; Laws 2000, LB 900, § 195; R.S. Supp., 2002, § 46-656.19; Laws 2004, LB 962, § 52; Laws 2006, LB 1226, § 22. Effective date: July 14, 2006

## References

Lower Platte South Natural Resources District, 1995. Ground water management plan. Lower Platte South NRD. 65 p. plus appendices.

Nebraska Groundwater Management and Protection Act

Papio-Missouri River Natural Resources District, 1994. Ground water management plan. Papio-Missouri River NRD. 82 p. plus appendices.

PRELIMINARY DRAFT

## **Action Item:**

### **Identify Funding Opportunities for IMP Implementation**

During development of the Voluntary Integrated Management Plan (IMP) for the Pappio-Missouri River Natural Resources District (P-MRNRD), projects, programs, and activities (PPAs) were identified to promote the goals and objectives of the plan. In order to accomplish many of these PPAs funding will need to be secured. For example, cost share programs were identified as an option to promote water conservation measures in both urban and rural settings. To fund the cost share programs, the P-MRNRD will need to identify appropriate funding sources and partners to implement cost share and other programs. Equally important are flood control structures to protect human life and infrastructure. For this reason, a review of funding options was completed and the following compendium of federal, state and local funding options is presented. The primary sources of funding for IMPs and GWMPs are the Natural Resources Conservation Service, Nebraska Department of Environmental Quality, Nebraska Environmental Trust, Nebraska Game and Parks Commission, and the funds administered by NDNR including the new Water Sustainability Fund. The general criteria and applicability of each of the funding sources are presented. It should be noted, however, that the funding sources presented here are not necessarily inclusive of all funding options available. Additionally, information presented here is subject to change as funding sources may change their terms and criteria. A summary of the funding opportunities can be seen in Table 1.

#### **Federal Funding Opportunities**

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##### **Natural Resource Conservation Service (NRCS)**

- **Environmental Quality Incentives Program (EQIP).** Through EQIP, technical assistance, cost-share and incentive payments are available to agricultural producers to implement conservation practices that improve water quality, enhance grazing lands, and/or increase water conservation.
- **Conservation Stewardship Program (CSP).** The CSP is available to all agricultural producers regardless of operation size or crop type. The program assists agricultural producers in improving their conservation systems and implementing additional conservation systems.
- **Environmental Quality Incentives Program (EQIP).** EQIP provides technical and financial assistance to agricultural producers on a voluntary basis for a maximum of ten years. EQIP aids in the implementation of conservation practices related to soil, water, plant, animal, air, agricultural land, and forestland.
- **Agricultural Conservation Easement Program (ACEP).** Helps to conserve agricultural lands by preventing the conversions of these lands into non-agricultural lands. This program also acts to protect the restore wetlands.
- **Resource Conservation and Development (RC&D).** Nebraska's RC&D areas assist communities by promoting conservation, development, and use of natural resources; improving the general level of economic activity; and enhancing the environmental standard of living for residents of those communities.

##### **U.S. Department of the Interior – Bureau of Reclamation**

- WaterSMART grants are provided to irrigation districts, water districts, and other organizations with water or power delivery to cost-share on projects that conserve and use water more efficiently. The projects should support water sustainability in the west.

#### **State Funding Opportunities**

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**The Nebraska Environmental Trust (NET).** The Nebraska Environmental Trust was established in 1992 to conserve, enhance, and restore the natural environments of Nebraska. The Trust especially seeks



projects that bring public and private partners together collaboratively to implement high-quality, cost-effective projects.

#### **Nebraska Department of Environmental Quality (NDEQ)**

- **Nonpoint Source Water Quality Grants (Section 319).** Under Section 319 of the federal Clean Water Act, the federal government awards funds to the Nebraska Department of Environmental Quality to provide financial assistance for the prevention and abatement of nonpoint source water pollution. This funding is passed through to units of government, educational institutions, and non-profit organizations for projects that facilitate implementation of the state Nonpoint Source Management Plan.

#### **Nebraska Game and Parks Commission (NGPC)**

- **Nebraska Wildlife Conservation Fund.** The purpose of this fund is to conserve nongame species and species determined to be endangered or threatened, for human enjoyment, for scientific purposes, and to ensure their continued existence as a part of our natural world.

#### **Nebraska Department of Natural Resources (NDNR)**

- **Water Sustainability Fund.** The Water Sustainability Bill (LB 1098) was signed into law during the 2014 legislative session. This bill creates the Water Sustainability Fund, which will be used to address multiple water management and quality issues. This fund will act to improve water quality and usage, supply water management goals, evaluate flood control, and comply with existing interstate agreements and compacts.
- **Water Well Decommissioning Fund.** The objective of the Water Well Decommissioning Fund is to encourage proper decommissioning of illegal water wells in the state. This is accomplished through providing financial incentives in the form of cost-share assistance.
- **Nebraska Soil and Water Conservation Fund.** This fund provides state financial assistance to Nebraska landowners for installation of approved soil and water conservation measures that improve water quality, conserve water, and help control erosion and sedimentation.
- **Small Watersheds Flood Control Fund.** The purpose of this fund is to assist local sponsors with the acquisition of land rights for flood control projects. Local sponsors use the fund to acquire easements or fee title to tracts that are needed to implement a project.
- **Natural Resources Water Quality Fund.** This fund was created to provide state funds to NRDs for their water quality programs.

#### **Local Funding Opportunities**

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It is the intent of the Lower Platte North NRD to utilize qualified projects described in Neb. Rev. Stat. § 2-3226.04 to provide river-flow enhancement in order to achieve the goals and objectives of the Lower Platte North NRD and to achieve the goals and objectives of the NDNR under the Groundwater Management and Protection Act. The Lower Platte North NRD may fund projects through one of two ways.

- **Levy Authority (Neb. Rev. Stat. § 2-3225(1)[c]).** This authority allows the Lower Platte North NRD to levy an additional property tax of up to three cents per \$100 of taxable value for purposes of administering and implementing groundwater management activities and integrated management activities under the Nebraska Groundwater Management and Protection Act. The Revenue Committee amendment to LB 1032 extended the sunset date to fiscal year 2016–17.
- **Occupation Tax (Neb. Rev. Stat. § 2-3226.05).** This authority allows the Lower Platte North NRD to levy an occupation tax upon the activity of irrigation of agricultural lands on an annual basis. This tax is not to exceed ten dollars per irrigated acre.

#### **Non-Profit Funding Opportunities**

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### **The Nature Conservancy (TNC)**

- The Nature Conservancy is the leading conservation organization working around the world to protect ecologically important lands and waters for nature and people. The Conservancy partners with indigenous communities, businesses, governments, multilateral institutions, and other non-profits to pursue non-confrontational, pragmatic solutions to conservation challenges.
- The Conservancy has protected over 107,000 acres in Nebraska through fee-title ownership, easements and deed restrictions, and assisting others with land transactions. TNC works in partnership with farmers and ranchers to promote good stewardship. TNC looks for ways to restore and protect grasslands and rivers.

### **Pheasants Forever (PF)**

- Pheasants Forever is dedicated to the conservation of pheasants, quail and other wildlife through habitat improvements, public awareness, education and land management policies and programs.
- Nebraska has 60 Pheasants Forever (PF) chapters and 3 Quail Forever (QF) chapter with over 10,388 members. In 2012, Nebraska PF and QF chapters have spent over \$4.9 million in the state on 5,456 habitat projects benefiting 148,597 acres.

### **Ducks Unlimited (DU)**

- Ducks Unlimited (DU) is the world's leader in wetlands and waterfowl conservation. DU got its start in 1937 during the Dust Bowl when North America's drought-plagued waterfowl populations had plunged to unprecedented lows. Determined not to sit idly by as the continent's waterfowl dwindled beyond recovery, a small group of sportsmen joined together to form an organization that became known as Ducks Unlimited.
- Nebraska includes diverse wildlife habitats like the Sandhills and the Missouri River floodplain. While most waterfowl migrate to wintering habitats further south each fall, large numbers of mallards and Canada geese do remain in Nebraska during the winter, particularly along the Platte River. DU's highest priority in Nebraska is to protect and restore critical migration habitat in the Rainwater Basin and along the Platte River. It is important that waterfowl arrive in their northern breeding habitats in the Prairie Pothole region in good physical condition, ready to undergo the physically demanding reproductive period. This will be accomplished by providing high quality migration habitat in Nebraska's Rainwater Basin and along the Platte River corridor.

**Table 1  
Primary Potential Funding Opportunities**

Agency/Entity	Program Name	Project Type(s)	Internet URL	Telephone
<b>Federal</b>				
Natural Resources Conservation Service (NRCS)	Environmental Quality Incentives Program (EQIP)	Promotes Conservation	http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/	(888) 526-3227
	Conservation Stewardship Program (CSP)	Promotes Conservation		
	Environmental Quality Incentives Program (EQIP)	Promotes Conservation		
	Agricultural Conservation Easement Program (ACEP)	Promotes Conservation		
	Resource Conservation and Development (RC&D)	Promotes Conservation		
U.S. Department of the Interior – Bureau of Reclamation	WaterSMART	Promotes Water Management	http://www.usbr.gov/WaterSMART/	N/A
<b>State</b>				
The Nebraska Environmental Trust (NET).	N/A	Acts to Conserve, Enhance, and Restore Natural Environments	http://www.environmentaltrust.org/grants/index.html	(402) 471-5409
Nebraska Department of Environmental Quality (NDEQ)	Nonpoint Source Water Quality Grants (Section 319)	Promotes Water Quality	http://deq.ne.gov/NDEQProgram.nsf/OnWeb/NSWQG	(402) 471-2186
Nebraska Game and Parks Commission (NGPC)	Nebraska Wildlife Conservation Fund	Protects Threatened and Endangered Wildlife	http://outdoornebraska.ne.gov/wildlife/programs/nongame/checkoff.asp	(402) 471-0641
Nebraska Department of Natural Resources (NDNR)	Water Sustainability Fund	Promotes Conservation	http://www.dnr.ne.gov/	(402) 471-0575
	Water Well Decommissioning Fund	Promotes Water Quality and BMP		
	Nebraska Soil and Water Conservation Fund	Promotes Conservation		
	Small Watersheds Flood Control Fund	Land Protection		
	Natural Resources Water Quality Fund	Promotes Water Quality		
<b>Local</b>				
Levy Authority (Neb. Rev. Stat. § 2-3225(1)(c))	N/A	Promotes Water Management	http://nebraskalegisature.gov/laws/statutes.php?state=2-3225	N/A
Occupation Tax (Neb. Rev. Stat. § 2-3226.05)	N/A	Promotes Water Management	http://nebraskalegisature.gov/laws/statutes.php?state=2-3226.05	N/A
<b>Non-Profit</b>				
The Nature Conservancy (TNC)	N/A	Promotes Conservation	http://www.nature.org/	(402) 694-4191
Pheasants Forever (PF)	N/A	Protects Threatened and Endangered Wildlife	https://www.pheasantsforever.org/	(877) 773-2070
Ducks Unlimited (DU)	N/A	Protects Threatened and Endangered Wildlife	http://www.ducks.org/	(402) 988-2260

\*\*\* The Conservation Security Program (CSP) was not reauthorized in the 2008 Farm Bill and is no longer available. A program in the 2008 Farm Bill, the Conservation Stewardship Program, is very similar to the Conservation Security Program.

\*\*\* The Agricultural Act of 2014 (enacted on February 7, 2014) repealed the Wildlife Habitat Incentive Program (WHIP).

\*\*\* The Agricultural Act of 2014 establishes the Agricultural Conservation Easement Program (ACEP). It repeals Wetland Reserve program, Grassland Reserve Program, and Farm and Ranch Lands Protection Program.

## **Action Item:**

### **Examination of Data Collection, Analysis, and Reporting**

During development of the Voluntary Integrated Management Plan (IMP) for the Papio-Missouri River Natural Resources District (P-MRNRD), data collection, analysis, and reporting were identified to be examined to promote the goals and objectives of the plan. This examination of the current water management datasets included the P-MRNRD and Nebraska Department of Natural Resources (NDNR) INSIGHT databases. Water management datasets are collected by both organizations to aid in the NDNR appropriation status determination and support water management decisions. The NDNR is responsible for collecting surface water information within the IMP area. The P-MRNRD is responsible for collecting groundwater information within the IMP area.

#### **Data Collection, Analysis, and Reporting**

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##### **NDNR Datasets**

- **Streamflow.** Streamflow data is collected by stream gages located within and outside of the IMP area. Stream gages used to aid in the appropriation status determination include the Platte River at Louisville and the Elkhorn River at Waterloo gages. There are additional stream gages within the IMP area that collect data for various waterways.
- **Surface Water Irrigation.** The NDNR maintains a surface water appropriation database. This database contains a list of the surface water irrigators and their location within the IMP area. The permits are used to determine the surface irrigation demand of a particular area.
- **Surface Water Use Non-irrigation.** The NDNR maintains a surface water appropriation database. This database contains a list of the surface water permitted uses within the IMP area. The surface water permitted uses are used to calculate the surface water demand for the appropriation status determination.

##### **P-MRNRD Datasets**

- **Groundwater Irrigation.** The P-MRNRD is certifying groundwater irrigated acres. This certification process will create a database of the groundwater irrigated acres within the IMP area. Certified groundwater irrigated acres are used in appropriation status determination.
- **Groundwater Use Non-irrigation.** The P-MRNRD maintains a database of groundwater permits within the district. The groundwater permits are used to calculate the groundwater use within the IMP area.
- **Groundwater Levels.** The P-MRNRD collects static groundwater level measurements within the district. These measurements help determine the change in groundwater levels throughout the IMP area.

#### **Additional Data Collection**

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Additional data may be collected throughout the IMP area that can aid in the Appropriation Status determination. The data collection may gathered on a voluntary basis.

- **Municipal and Industrial Water Use.** A voluntary reporting form could be created for municipal and industrial waters use. The reporting form could include data collection of pumping rates for the type of water use. This data would aid in the determination of industrial and municipal water demand in the IMP area.
- **Irrigation Water Use.** A voluntary reporting form could be created for irrigation water use. This form could allow irrigators to enter the pumping rate for the year. This data would aid in the understanding of the net crop irrigation requirement for the IMP area. This type of data reporting would need to be stressed that it would be collected on a voluntary basis.

## Identify Options and Protocols for Water Consumption Estimates

During development of the Voluntary Integrated Management Plan (IMP) for the Pappio-Missouri River Natural Resources District (P-MRNRD), one of the action items identified for further evaluation were options and protocols for developing estimates of water consumption. The following information is presented to assist the P-MRNRD identify such options and protocols.

Not all water consumption is of equal value and some, as described below, is so minimal as to not merit much consideration or effort to quantify. Understanding the social and economic value of various types of consumption, along with the degree to which various types of consumption are occurring will allow water managers and the public to prioritize how supplies can or should be developed, used, conserved and even quantified.

Initially to estimate consumptive use it is important to distinguish between the concepts of water use and water consumption. When water is consumed it is no longer available for use in the area of interest. If it is simply used it remains available in the area for potential reuse. Water that is not consumed either infiltrates into the ground, resulting in aquifer recharge, or runs off the land surface and produces stream flow. Each of these water pathways are beneficial as well and are important considerations for water managers. In some cases this reuse may require some additional level of infrastructure or treatment but it is still available for use within the area of interest.

Next to identify options for consumptive use estimates we must define the range and extent of consumptive use we wish to quantify. Consumptive use on a physical scale can be broadly interpreted to consider all forms of loss of availability such as the conversion of liquid water to vapor, pollution to the point of it not being practically recoverable or it may simply flowing out of the area of need. Downstream demand is many times perceived to be non-consumptive but to the upstream area where water is discharged from this expectation is 100% consumptive.

Consumptive use from a regulatory perspective can be limited to considering only specific man induced uses such as irrigation, reservoir evaporation and municipal/industrial consumption. This is the primary model for consumption described by the NDNR Insight process. An estimate of the degree this concept limits the consideration of local consumption can be based on the fact that it generally includes less than 20% of the total consumption associated with a given areas landscape.

Use of results from the October 29, 2013, P-MRNRD Water Balance Study (WBS) can be an important source for various values of measured and unmeasured consumption and use of water in the Hydrologically Connected Area (HOA) of the P-MRNRD.

An example of the important components necessary for total consumption estimating is taken from the WBS and attached below:

**Table ES-1. Summary of Water Balance Components**

Component	Quantity
Land area (acres)	228,000
Land use percentages	
Dryland crops	56%
Pasture/Grassland	15%
Irrigated crops	11%
Forested areas	9%
Urbanized lands	5%
Average annual precipitation, 1949-2012 (inches)	30
Average annual surface water inflows not including Platte River, 1980-2011 (acre-feet)	1,385,000
Average annual municipal wellfield pumping, time period varies(acre-feet)	131,000
Average annual subsurface inflow and outflow, assumed (acre-feet)	Negligible
Average annual surface water outflow, 1980-2011 (acre-feet)	1,492,000
Average annual consumption (using 1949-2012 climate data) based on 2005 land use (acre-feet)	477,000
Percentage of total NRD consumption supplied by rainfall	98%
Percentage of total NRD consumption provided by supplemental irrigation	2%
Percentage of total NRD consumption from pasture/ grassland use	17%
Percentage of total NRD consumption from dryland crops	48%
Average annual change in groundwater storage	Negligible
Average annual change in surface water storage	Negligible

Another example table taken from the WBS and included below can also indicate how these components can be utilized to understand their relevance and relative accuracy in producing water sustainability:

**Table ES-2. Components of the Average Annual Water Balance Based on Current Land Uses**

	Amount (KAF)	Period of Assessment
<b>Inflows</b>		
Precipitation	568	1980-2012
Gaged surface water inflow	1,167	1980-2011
Minor tributary inflow	218	1980-2010
Subsurface inflows	0	
<b>Total</b>	<b>1,953</b>	

<b>Outflows</b>		
Consumption	465	1980-2012 (based on 2005 land use)
Gaged surface water outflow	1,425	1980-2011
Minor tributary outflow	67	1980-2010
Subsurface outflow	0	
<b>Total</b>	<b>1,957</b>	
<b>Change in Storage</b>		
Groundwater storage	0	
Surface water storage	0	
<b>Total</b>	<b>0</b>	
<b>Remainder</b>	<b>-4</b>	

Information used to create the tables above can be update, expanded on and improved to better understand, quantify, trend and document changes to both historically measured and unmeasured consumption and correlated to impacts associated with changes in the level of water development.

An important and somewhat simplifying approach to physical consumptive use estimations is the fact that the vast majority of the total consumption is associated with natural and agricultural evapotranspiration (ET) and direct outflow with only a minute and largely de minimis component of the total area consumption associated with domestic, livestock, municipal and industrial consumption. One important exception to this rule is when evaporation towers are used to cool major industrial and power generation facilities.

Various mechanisms can be used for calculating general ET on a landscape scale basis include direct measurement such as Dr. Suat Irmak's Bowen Ratio and Eddy Covariance stations at UNL, implementation of the CropSim model developed by Derrel Martin at UNL and application of various methods of remote sensing such a CREMAP developed by Dr. Jozsef Szilagyi, at UNL and METRIC a variant of SEBAL, developed in the Netherlands and adapted by Dr. Rick Allen at the University of Idaho and applied by Dr. Ayse Kilic at UNL.

The following excerpts were taken directly from the WBS. It describes how CropSim was applied to estimate landscape based consumption in the HOA and how CREMAP could be used to confirm these estimates and possibly even future compliance. Various tables from the WBS can also be utilized, as described above, to estimate water use, consumption and consumptive use within the HOA.

### **1.1.1 Consumption Estimates and Data**

*Consumption of water by native vegetation, crops, wetlands, forests, etc. within the IMP Area was calculated based on current land uses. The consumption estimates presented in this report represent expected average levels of consumption based on current land uses assuming that long term trends in temperature and precipitation persist into the future. The estimates do not represent historical amounts of consumption that are dependent on specific climatic conditions*

and historical land use changes such as conversion of grassland to dryland farms, changes in crops grown, growth of towns and cities, etc. Current (2005) land use was incorporated into the consumption estimates, because it best represents the type and magnitude of water consumption that is presently occurring within the IMP Area.

Two types of data were necessary to estimate volumes of consumption: land use mapping and annual amounts of consumption for various land uses in terms of inches per acre. A description of the data sources and processes for developing input data are described below:

#### **1.1.1.1 Land use**

Land use data from 2005 was obtained from GIS-based mapping developed by CALMIT. The mapping was developed using multi-date satellite imagery and has a 28.5 meter resolution. Land use was categorized into 25 different classes reflecting a variety of irrigated and dryland crops, grasslands, urban areas, open water, etc. The classification of various land uses was estimated by CALMIT to be approximately 81% accurate. The 2005 CALMIT land use mapping covers the entire state of Nebraska. For the purposes of this study, it was assumed to represent current land use conditions. GIS was used to extract land use data for areas within the IMP Area boundary.

#### **1.1.1.2 Rates of consumption**

Annual rates of water consumption for various land uses were estimated using the CropSim model. CropSim calculates consumption for various types of crops and vegetation growing on various types of soils. It has been applied in many areas of Nebraska for various hydrologic modeling studies.

For this study, most of the CropSim code and input parameters were useable for estimating consumption in the IMP Area. However, based on discussions with Dr. Derrel Martin (University of Nebraska professor and creator of CropSim), input parameters describing the growth and water use of pasture and grassland were modified to reflect tall grass prairies that are present in eastern Nebraska.

#### **Tall grass crop coefficients**

Seasonal amounts and patterns of water use for pasture and grasslands are reflected in “crop coefficients”. CropSim uses crop coefficients that have been derived for a variety of crops and other vegetation to convert consumption estimates for a “reference crop” to consumption estimates for specific crops and vegetation. Information describing crop coefficients for tall grass prairie were obtained from research conducted at the Konza Prairie in northeastern Kansas (Hutchinson, et al., 2001; Hutchinson, et al., 2008). The research included a profile of how crop coefficients for tall grass prairie at the site changed throughout the growing seasons during the period of research. The crop coefficients and patterns of seasonal change were input into the CropSim model along with parameters that signal when seasonal changes occur (i.e. growing degree days).

#### **Weather data**

CropSim uses daily temperature and precipitation data and reference crop evapotranspiration estimates to calculate daily consumptive use amounts, track available water in the soil profile, etc. Brown and Caldwell assembled weather data and conducted reference crop



evapotranspiration calculations to develop a set of input data for CropSim. The weather and reference crop evapotranspiration data covered the January 1, 1949 through December 31, 2012 timeframe. Data sources and calculation procedures are described below.

Long-term, daily temperature and precipitation records were available for weather stations near Ashland and Fremont. Both of these locations are just west of the IMP Area. Brown and Caldwell searched for a weather station with long-term daily records of temperature and precipitation in the eastern part of the IMP Area, but no complete data sets were identified. As a result, records from several weather stations in/near the eastern part of the IMP Area were combined to develop a continuous long-term record of daily temperature and precipitation data that is generally representative of climatic conditions in the eastern part of the IMP Area. The combined weather records representing the eastern portion of the IMP Area will hereinafter be referenced as the Eastern Composite data set. The daily temperature and precipitation records for the Eastern Composite data set were developed as follows:

- *Temperature data:* The Springfield 7E weather station (a National Weather Service Cooperative Observer Program weather station) is located in the eastern part of the IMP Area and has daily high and low temperature records spanning the time period of January 1, 1995 to December 31, 2012. Using the Springfield 7E and Ashland data, linear relationships between daily high and low temperatures were developed for these two stations. The relationships were used to estimate daily high and low temperatures for the Eastern Composite data set for the years 1949 through 1994 based on daily data at the Ashland weather station. Daily high and low temperature data from the Springfield 7E station were used in the Eastern Composite data set for the years 1995 through 2012.
- *Precipitation data:* The Plattsmouth 1 E weather station (a Global Historical Climatology Network station) is located near the southeast corner of the IMP Area. The daily precipitation records for this station span the 1949 through 2012 timeframe and are 98% complete, but several days are missing from the record. Daily precipitation data from the Glenwood 3 SW (another Global Historical Climatology Network station just across the Missouri River in Iowa) were used to fill in data gaps when data from this station were available. If data were not available from either the Plattsmouth or Glenwood stations, daily precipitation data from Omaha Epply airfield were used.

### **Reference crop evapotranspiration**

Daily reference crop evapotranspiration ( $ET_r$ ) was estimated using the Hargreaves method (Hargreaves and Samani, 1985) with location-based adjustments recently developed by the University of Nebraska (Mortensen, 2010). The Hargreaves method uses extraterrestrial radiation and daily maximum and minimum temperature data to estimate  $ET_r$ . The University of Nebraska developed relationships between the Hargreaves method and the Penman-Monteith method (a more accurate but data-intensive method for estimating  $ET_r$ ) and an equation that adjusts  $ET_r$  based on geographic location. Daily minimum and maximum temperatures from the Ashland, Fremont, and Eastern Composite data sets were used with the Hargreaves equation and the geographical adjustment developed by the University of Nebraska to estimate  $ET_r$  for each of the respective weather stations used to estimate consumptive use in the IMP Area.

#### **1.1.1.3 Data processing**

Soil mapping was obtained and was combined with mapping of 2005 land use, weather stations, and the IMP Area boundary in GIS. Each of these mapping coverages were intersected in GIS,

which resulted in a mapping coverage that included polygons with attributes describing specific soil types, land uses, and coverage of weather stations. For each of these polygons, annual consumption estimates could be obtained based on the soil type, land use, and weather station used by CropSim. The extraction of CropSim output for each individual polygon was conducted using database queries. Annual consumption volumes based on 2005 land uses were estimated by multiplying annual consumption amounts for various soil types, land uses, and weather stations (in terms of inches per acre) by the land area of polygons with corresponding land use, soil type, and weather station attributes. The annual consumption volumes calculated for each polygon were summed to obtain annual consumption volumes on an IMP Area-wide basis. The consumption amounts calculated using this process represent consumption relative to 2005 land uses projected across historical climatic records.

#### 4.2 Data Comparisons and Improvements

Some of the estimates for components of the water balance were compared with estimates that have been developed using different methods. For example, Dr. Jozsef Szilagyi, Research Hydrologist at the University of Nebraska, has been conducting spatially distributed estimates of consumption in Nebraska using the Complementary-Relationship-Based Evapotranspiration Mapping (CREMAP) method. CREMAP uses daytime surface temperature (acquired via satellite) and atmospheric data (mean air temperature, humidity, sunshine radiation, etc.) to estimate latent heat flux on a monthly timestep (Szilagyi, et al., 2011). Figure 4-1 shows mapping of average annual consumption (2000 through 2009) for the entire state of Nebraska. Dr. Szilagyi provided CREMAP estimates of consumption for 2000 through 2009 for the IMP Area. He also provided estimates of precipitation for the same time period. Precipitation data were obtained from the PRISM database and are at a 2.5 minute aerial resolution. Table 4-1 shows a comparison of precipitation and consumption estimates averaged over the 2000 to 2009 time period using both CREMAP and the methods described in this report.

**Table 4-1. Comparisons of Consumption and Precipitation Derived by Different Methods**

Avg. Annual CREMAP consumption (2000-2009) (KAF)	Avg. Annual Consumption based on methods in this report (2000-2009) (KAF)	Consumption Ratio (CREMAP/this study)	Avg. Annual Precipitation from PRISM database (2000-2009) (KAF)	Avg. Annual Precipitation based on methods in this report (2000-2009) (KAF)	Precipitation Ratio (PRISM/this study)
495	463	1.07	547	545	1.00

Table 4-1 shows that estimates of consumption and precipitation were very similar in each method, and estimates using both methods are likely adequate for identifying potential management opportunities and comparing alternatives. The two methods were not analyzed to assess the reason for the differences or to determine which methodology yields more accurate results. It should be noted that the CREMAP method estimated higher average annual amounts of consumption, which tends to agree with the observation described in Section Error! Reference source not found. that consumption may be slightly understated because of unquantified evaporative losses from runoff stored in small impoundments such as roadway ditches and

*small farm ponds. Another potential reason for differences in the methods is that this study relied on 2005 CALMIT data for land uses and assumes those land uses represent conditions from 2000 to 2009. CREMAP results reflect consumption from actual land uses during the 2000 to 2009 time period. Differences between the two methods could occur if actual land uses during the 2000 to 2009 time period varied from those in 2005 that were used for this study.*

*Both the method used in this study and the CREMAP method for consumption quantification provide a tool for the P-MRNRD to improve its understanding of the hydrology in the IMP Area. The method used for this study (based on CropSim) provides a tool to quantify consumption specific to various land use types in the area and to devise consumption trade off opportunities among the various land uses. However, because the information used to develop consumption estimates (CALMIT land use, CropSim output, etc.) is not available in “real-time,” it is not easy to develop regular, current estimates of consumption in the basin. CREMAP is a tool that could be used for this purpose. However, real-time data analysis to support the CREMAP methodology is not currently being developed by the University of Nebraska. The P-MRNRD could partner with others in the state to support the development of real-time data and to make it available and usable for water management into the future.*

The above is an example of how CREMAP can be applied to estimate and confirm landscape ET consumption. CREMAP could also be an excellent trending and compliance tool for total area ET estimates but it is limited by a relatively short application period of from 2000 to 2009. Its value as a tool could be greatly enhanced with an effort to extend the analysis period to current and to then update the current data to the latest data available. There is an interest in the academic community in producing this update and something that could be accomplished for, at least, the entire state of Nebraska for an estimated total cost of from \$30-\$50,000.

The single greatest drawback to applying CropSim is the availability of current land use information. The CropSim ET estimate provided by the WBS was based on 2005 land use data derived from a statewide CALMIT effort. Again, with adequate interest, initiative and resources, it is possible that this critical land use data could be updated to and maintained as current or even trended over time if this type of land use change were valuable to understand.

To get a sense of the amount of direct outflow consumption, the second largest depletion to a give area, requires adequate and appropriate stream flow data to be collected. To accomplish this requires stream gages to be located at area boundaries or local gage data to be adjusted to meet these requirements. An inventory of the area of interest can determine if this information is readily available or if it is even possible or worthwhile to collect this understand.

As discussed above, all other consumption in an area of interest are very small and likely negligible when compared to those of total ET and surface outflow. Groundwater outflow, except for that directly related to stream alluvium which is also closely related to the amount of surface flow, is limited in both extent and amount in the rest of this basin so it cannot be expected to have much management potential.

Likewise, most domestic, livestock, municipal and industrial use is only minimally consumptive except for summer lawn watering and possibly large plant evaporative cooling do not provide important opportunities for consumption reduction and are therefore not worth much effort to quantify.

As long as the effluent discharge can be reasonably treated, the only actual consumption associated with indoor household use is generally minor amounts of evaporation. Household consumption is generally represented by things like steam from showers or cooking, evaporation from clothes or dish drying and evaporation of perspiration. The remainder of the indoor use is generally discharged to some form of treatment and returned to the local water supply. This is not to diminish the importance of indoor water use reduction to reduce treatment and energy costs but it is not an important place for water consumption reduction.

Although some component may return to the basin, urban lawn watering can be a highly, 90% or more, water consumptive activity. To quantify this consumption one can look into the monthly distribution of local municipal systems water pumping and, if available, return flow values to determine the difference between fall and winter month values and summer, lawn watering, values to quantify the amount of associated water consumption.

Because of the discussion above it is likely that this water consumption estimate value should be adequate to determine the amount of actual water conservation potential that may exist. To capture the impact of rural domestic users a similar proportion could be applied to their aggregate number.

Understanding, quantifying and managing this largely consumptive component of urban water use can have other significant benefits however. Beyond the large direct cost saving potential associated with reduced energy and treatment cost, it is this summer peak demand that adds significantly to peak loading that drives increased infrastructure installation, operation and replacement costs.

Large scale industrial cooling for uses such as Ethanol or power production water consumption could be estimated based on their amount of energy consumed. This would likely over estimate the actual amount of cooling water consumption but this over estimate would be offset by their actual plant water requirements, which are often required to be evaporated on site.

For the more physically based agricultural consumptive use estimates, it is important to consider two distinct measures, one for the individual producer and what he can do and what it means to his specific operation. The other is what this impact is and can be if aggregated with or extrapolated to more or all producers in an area, sub-basin or entire river basin. This difference can also impact and require adjustment for physical realities such as transportation losses and lag effects. Therefore, I see these as potentially two separate and specific measurement actions and/or opportunities requiring somewhat different background and baseline activities to measure success.

To somewhat crudely measure the first one could gather their historic records and compare current and future process and water outcomes to this historic record. Another somewhat crude opportunity might be to measure and document side-by-side comparisons of the new process with the legacy or past process. To possibly apply more refined methods one could look at direct measurements of ET between current and new technologies using Bowen Ratio or Eddy Covariance measurement techniques but this is likely to be very time and resource costly. Another and emerging opportunity would be to measure water consumption change with LANDSAT 7 and 8 satellite remote sensing.

To meaningfully measure the second larger aggregate scale outcomes can be more involved but will still be dependent on adequate and appropriate back ground data and baselining. This

could involve collecting and assessing land use and related ET consumption for the entire area. Similar efforts such as listed above would likely be workable here as well. The additional challenge here will be to properly identify and quantify the boundary conditions as well as changes in the other relevant parameters such as changes to and variability of precipitation, total area ET, surface and groundwater flow amounts in and out and soil, groundwater and surface storage levels, lag effects and transportation losses all over time and into the future.

Devise a protocol to complete water budget process to identify, develop and utilize comprehensive, practical, flexible and physically based water related measurement.

- Use water budget inventories to quantify the water supply and how it is consumed.
- Monitor and record past, present and future occurrence, change and trends.
- Identify and quantify potential alternative methods
- Reinforce commitment and provide credit for applying an alternative.

Devised a protocol to research, understand, educate, publicize, promote and implement alternative solutions.

- R and D work with producers, industry, UNL and other interested entities to identify, analyze and apply workable estimation concepts.
- Apply for a NET or other grants to help support the compilation of the research information and to help utilize it.
- Develop and foster education and media attention on the need for these efforts.
- Quantify alternative results and develop an implementation process.

Other supplemental information and data acquisition opportunities could utilize:

- Identification of Stream gage monitoring sites & placement
- Identification of Moisture probe sites & placement
- Identification of Weather Station sites & placement
- Identification of ET Gauge sites & placement

Ancillary values from the application of the above opportunities for irrigation and also rain fed management could be:

- Reduce over- & under-watering
- Optimize soil moisture for an optimized irrigation program
- Enhance nutrient availability and uptake
- Monitor and encourage root development with soil profile management at appropriate growth stages in season
- Reduce the incidence of root disease
- Record irrigation and rainfall events for future optimization considerations
- Track and manage induced stress on the crop
- Monitor irrigation frequency, amount of refill and penetration depths
- Evaluate the effectiveness of rain events and/or runoff

A very important component of any effort to increase and improve the understanding of current consumption and management opportunities will revolve around the use and extension of much of the data and information originally produced by the WBS. Also an ability to appropriately quantify and compare values developed by the WBS and subsequent extension and updates to the expectations and requirements of any NDNR appropriation determination or compliance will also be critically important.

To accomplish this will require the utilization and possibly further development and refinement of the data base information used to prepare the WBS and also to find way to conform and update this information relative to any NDNR processes.

Preliminary Draft