NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Little Blue NRD Oxbow Reconnections for Groundwater Recharge

PRIMARY CONTACT INFORMATION

Entity Name: Little Blue Natural Resources District

Contact Name: Mike Onnen

Address: 100 East 6th Street, P.O. Box 100, Davenport, NE 68335

Phone: (402) 364-2145

Email: monnen@littlebluenrd.org

Partners / Co-sponsors, if any: N/A

1. Dollar amounts requested: Grant

   Grant amount requested. $389,820

   Loan amount requested. N/A

   If Loan, how many years repayment period? N/A

   If Loan, supply a complete year-by-year repayment schedule.
   N/A

2. Permits Needed - Attach copy for each obtained (N/A = not applicable)

Nebraska Game & Parks Commission (G&P) consultation on Threatened and Endangered Species and their Habitat	N/A☐	Obtained: YES☐	NO☒
Surface Water Right	N/A☒	Obtained: YES☐	NO☐

USACE (e.g., 404 Permit)	N/A☐	Obtained: YES☐	NO☒
Cultural Resources Evaluation	N/A☐	Obtained: YES☐	NO☒
Other (provide explanation below) Floodplain Permit	N/A☐	Obtained: YES☐	NO☒

3. Are you applying for funding for a combined sewer over-flow project?

   YES☐ NO☒

   If yes, do you have a Long-Term Control Plan that is currently approved by the Nebraska Department of Environmental Quality?

   YES☐ NO☐

   If yes attach a copy to your application. Click here to enter text.

   If yes what is the population served by your project? Click here to enter text.

   If yes provide a demonstration of need. Click here to enter text.

   If yes and you were approved for funding in the most recent funding cycle, then resubmit the above information updated annually but you need not complete the remainder of the application.

4. If you are or are representing an NRD, do you have an Integrated Management Plan in place, or have you initiated one?

   N/A☐ YES☒ NO☐

5. Has this application previously been submitted for funding assistance from the Water Sustainability Fund and not been funded?

   YES☐ NO☒

   If yes, have any changes been made to the application in comparison to the previously submitted application? Click here to enter text.

   If yes, describe the changes that have been made since the last application. Click here to enter text.

   No, I certify the application is a true and exact copy of the previously submitted and scored application. (Signature required) Click here to enter text.

6. Complete the following if your project has or will commence prior to next July 1st.

As of the date of submittal of this application, what is the Total Net Local Share of Expenses incurred for which you are asking cost share assistance from this fund? $ Click here to enter text.

Attach all substantiating documentation such as invoices, cancelled checks etc. along with an itemized statement for these expenses. Click here to enter text.

Estimate the Total Net Local Share of Expenses and a description of each you will incur between the date of submittal of this application and next July 1st for which you are asking cost share assistance from this fund.
$ Click here to enter text.

Section B.

DNR DIRECTOR'S FINDINGS

Does your project include physical construction (defined as moving dirt, directing water, physically constructing something, or installing equipment)?

YES☒ NO☐

1(a). If yes (structural), submit a feasibility report (to comply with Title 261, CH 2) including engineering and technical data and the following information:

A discussion of the plan of development (004.01 A);

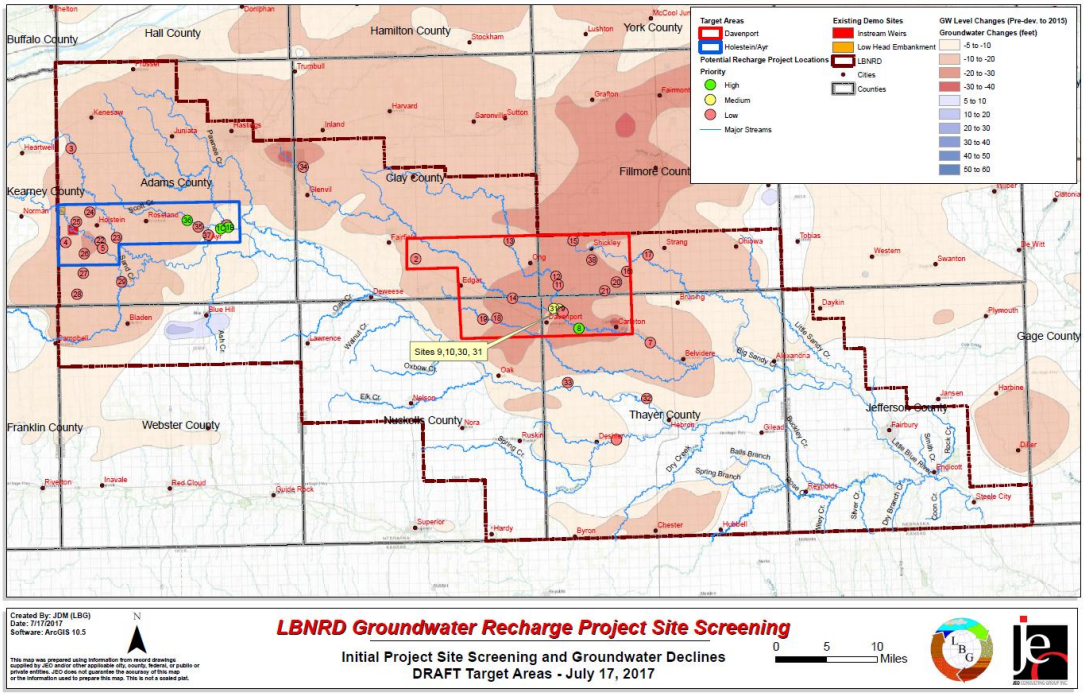
PROJECT OVERVIEW

The Little Blue Natural Resources District (LBNRD) is requesting Water Sustainability Funds (WSF) to cost-share the design, permitting, and construction of small instream weirs and remnant oxbows at four (4) sites within the Little Blue River basin and to install monitoring equipment at these sites to evaluate recharge performance.

These targeted recharge structures will provide multiple benefits that are consistent with the intent of the WSF Program. The small instream weirs and remnant oxbows will provide:

- groundwater recharge,
- flood control measures,
- streambank and streambed stabilization,
- water quality enhancements,
- wetland restoration, and
- creation of wildlife and waterfowl habitat.

Even though the project is at a conceptual design stage, the intent is that these recharge structures can be used as a template for other projects on a Statewide basis by demonstrating how improvements, such as small instream weirs and remnant oxbows, can provide many quantifiable benefits within a watershed or sub-watershed basin. A site map is provided below.



These recharge structures will be designed by professional engineers and geologists licensed in the State of Nebraska and other qualified environmental and water-resources professionals.

BACKGROUND

The LBNRD has many water resources issues in its service area. These problems include, but are not limited to: groundwater declines, flooding, streambank and streambed erosion and degradation, water quality impairments, loss of wetlands, wildlife, and waterfowl habitat.

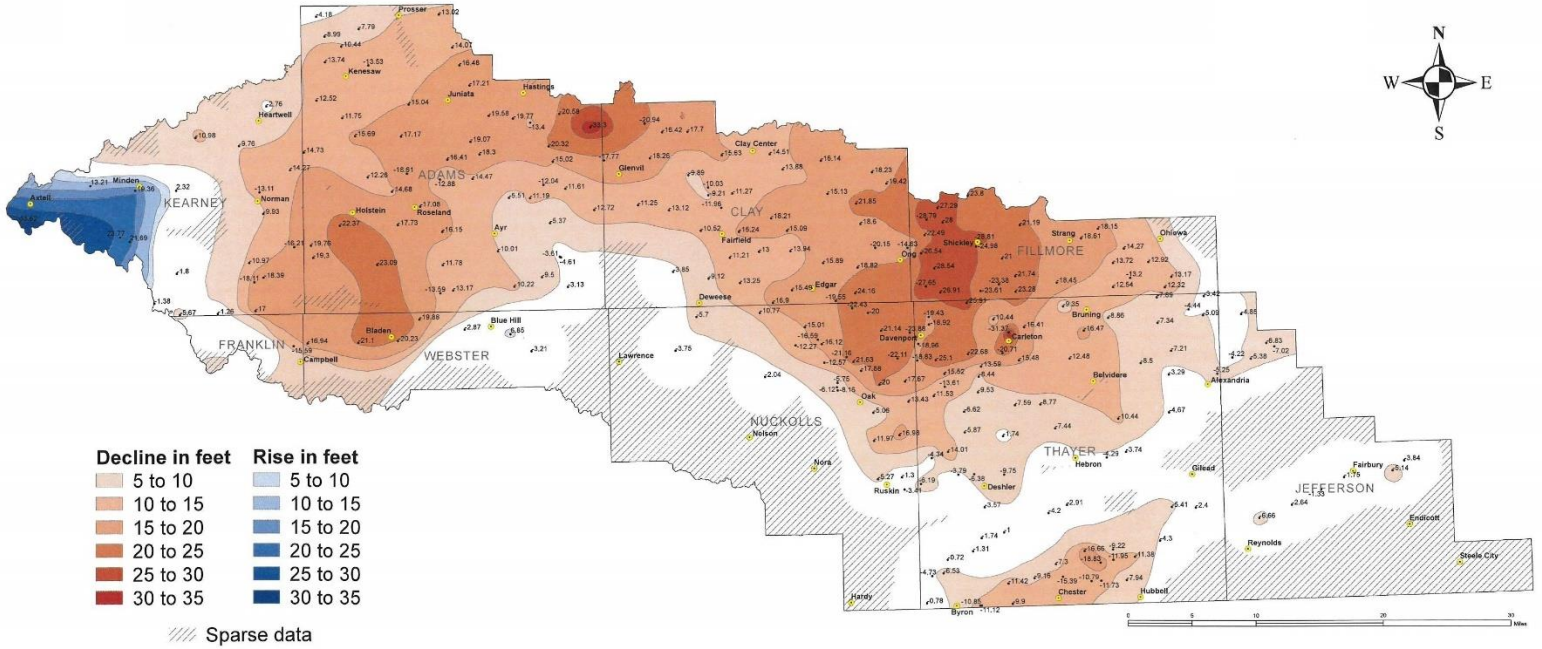
The LBNRD is experiencing significant groundwater declines in areas across the its service area. Groundwater levels have declined almost 30-feet in some locations, with declines of over 20-feet being widespread across LBNRD, see map below. Historically, flooding has occurred throughout the District. One major event occurred in May 2015 when a state of emergency was declared by Governor Pete Ricketts due widespread flooding that caused partial evacuations of some communities.

Surface-water quality is degraded in some locations. Of the 38 stream segments assessed by NDEQ, nine (9) were found to be impaired by pollutants such as atrazine and selenium. The 38 stream segments were also assessed for aquatic life and seven (7) were determined to be impaired. Groundwater contaminants, particularly nitrate, are a concern throughout the District. There are multiple wells in the LBNRD area where nitrate concentrations in the groundwater exceed the MCL of 10 mg/L. Several communities are currently implementing measures to protect consumers from excess nitrate contamination in drinking water supplies.

The degradation and loss of wetlands is a considerable issue throughout the LBNRD. The management goal of the U.S. Fish and Wildlife Service within the Rainwater Basin (which encompasses a portion of the LBNRD) is to restore, as much as possible, the natural hydrologic and ecological function of wetlands for the benefit of migratory birds and resident. Streambank and streambed erosion and degradation continue to release sediment and other pollutants into rivers and streams. Finally, as water flows out of the LBNRD, the State of Nebraska loses opportunities for conjunctive use of this valuable water resource.

The LBNRD uses proactive water management practices and has developed technical and policy documents to address the water resources issues in the District. In 2011, the LBNRD conducted a District-wide Hydro-geologic Study http://www.littlebluenrd.org/hydrogeologic_study.html to better understand and utilize their groundwater resources. In 2015, the LBNRD adopted the Little Blue Basin Water Management Plan (2015 WMP) http://www.littlebluenrd.org/Water/basin_water_plan.html, a comprehensive plan that has a coordinated strategy to identify water quality and quantity threats and needs, and identify practices and activities appropriate to address known deficiencies. The LBNRD has revised the Groundwater Management Plan and has submitted it to NDNR for review. The LBNRD is currently developing a Voluntary Integrated Management Plan http://jeo.com/projects/little-blue-vimp to comprehensively address water management issues in the District.

LBNRD Groundwater-Level Changes - Predevelopment to Spring 2017



Decline in feet	Rise in feet
5 to 10	5 to 10
10 to 15	10 to 15
15 to 20	15 to 20
20 to 25	20 to 25
25 to 30	25 to 30
30 to 35	30 to 35

Sparse data

Disclaimer: this map was created using 263 plotted points, constituting the best available data as of June 9, 2017. This map is intended to provide a general overview of regional variation, not site specific conditions.

School of Natural Resources
Institute of Agriculture and Natural Resources
University of Nebraska–Lincoln

CONSERVATION AND SURVEY DIVISION (http://snr.unl.edu/csd)
School of Natural Resources (http://snr.unl.edu)
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

Aaron Young, Survey Geologist, CSD
Les Howard, GIS Manager, CSD

June 2017

U.S. Geological Survey
Nebraska Water Science Center

Upper Big Blue Natural Resource District

Tri-Basin Natural Resource District

Central Nebraska Public Power and Irrigation District

In addition to the planning process and management actions, LBNRD is designing and building structures to help remediate water resources problems in the District. In 2017, and in partnership with the Nebraska Natural Resources Commission, LBNRD implemented the first phase of constructing small instream weirs and low-head embankment stabilization recharge projects to capture excess surface water flows. The project benefits are to: recharge the groundwater, reduce flooding, protect the streambank and reduce streambed degradation, improve water quality, restore wetlands, and create wildlife and waterfowl habitat. A detailed description of the first phase and the associated Feasibility Study can be found in Appendix A.

Due to the extensive magnitude of the water resources issues, and ultimately the cost to remedy the problem, the LBNRD's mitigation efforts will be phased over multiple years. As described previously, the first phase focuses on instream weirs that partially impound streamflow and thereby enhanced groundwater recharge. This second phase, discussed in the following Project Description Section of this proposal, will build upon these past efforts by installing four (4) recharge structures at selected site within the District and monitoring equipment to evaluate recharge performance. Engineering designs can be modified to improve performance and the most effective technologies will be deployed at these sites.

BENEFITS

- Groundwater Recharge. Small instream weirs and remnant oxbows will be designed to store excess flows that will infiltrate and recharge groundwater.
- Flood Reduction. Flood flows will be diverted into remnant oxbows that will provide off-channel storage and reduce peak flood flows.
- Streambank and Streambed Stabilization. Reducing peak flood flows will help prevent scour on the banks and in the channel. The instream weir will also provide grade control thereby reducing sediment loadings.
- Water Quality Improvement. Reducing peak flood flows will also help prevent mobilization of sediment and other pollutants. Remnant oxbows will be used to capture pollutants in runoff from adjacent fields.
- Wetlands Restoration and Creation of Wildlife and Waterfowl Habitat. Shallow standing water in the oxbows will create wetlands and provide excellent habitat for wildlife and waterfowl.

PROJECT DESCRIPTION

The Little Blue Natural Resources District (LBNRD) is requesting Water Sustainability Funds (WSF) to cost-share the design, permitting, and construction of four (4) small instream weirs and remnant oxbows at strategic locations within the District and to install monitoring equipment at these sites to evaluate recharge performance.

The Little Blue NRD Oxbow Reconnections for Groundwater Recharge is a phased project. As discussed previously, the first phase began in 2017 with the construction of small instream weirs and low-head embankment stabilization recharge structures to capture excess surface water flows. This second phase will

focus on the design and construction of reactivating remnant oxbows by reconnecting them to the river and installing small instream weirs. The LBNRD has completed a conceptual design for this second phase of projects and is incorporated into this study. The conceptual design utilized LiDAR, field reconnaissance, and available hydrologic and physical data to engineer the project. Final design, permitting, and construction will be completed upon award of the WSF grant

To assist in site selection, the LBNRD developed the Prioritization Methodology Report for Groundwater Recharge, Flood Protection, and/or Oxbow Reconnection Projects in June 2017 (Methodology), see Appendix B. The intent of the Methodology is to create a uniform process to screen and prioritize projects with the goal of groundwater recharge, flood reduction, streambank and streambed stabilization, water quality improvement, wetland restoration, and wildlife and waterfowl habitat creation. The Methodology created a uniform system to screen projects within targeted areas of the LBNRD that can be used each time new projects are considered. The site selection was a measured and detailed process. Multiple physical and hydrologic characteristics were examined for 38 sites to determine the best sites to achieve the project goals and for construction. The best projects are listed in the LBNRD Recharge Projects Evaluation Matrix shown below. For the complete Recharge Projects Evaluation Matrix for all 38 sites see Appendix C. Based on the Matrix, four (4) sites were selected for conceptual project design, including an initial permitting evaluation and wetland delineations.

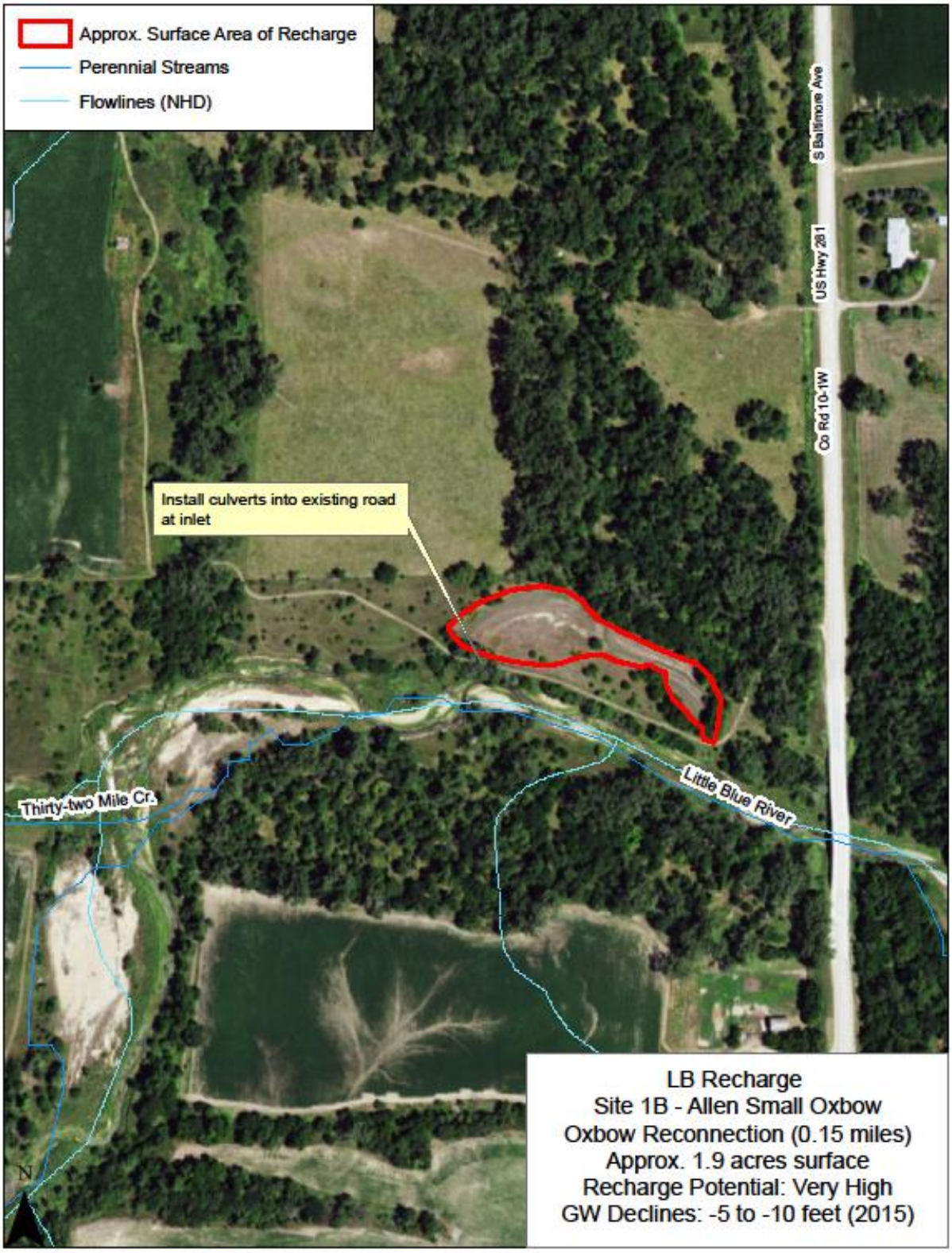
LB NRD Recharge Projects Evaluation Matrix			Technial Feasiblity	Construction Cost	Use of Existing Infrastructure	Site Access and Conditions	Aquatic Habitat Enhancement	Regulatory Implications	Groundwater Quality Impacts	Surface Water Quality Benefits	Water Source Availability	Proximity to Consumptive Uses	Flood Protection	Operation and Maintenance	Artificial Recharge Potential	Weighted Score
		Weighting Factor	*3*	*3*	*1*	*3*	*1*	*3*	*1*	*2*	*3*	*2*	*2*	*2*	*3*	125
Project #	**Project Name**	**Target Area**														
1B	Oxbow Reconnection (small) - NE of Ay	Ayr	3	5	4	5	4	4	1.5	4	4	4	2.5	3.5	4	96.5
36	Oxbow/weirs 3 NW of Ayr	Ayr	5	4	4	4	4	3	2	3	4	3	3	3	4	92.5
1C	In-stream Weirs - NE of Ayr	Ayr	3	4	4	5	4	4	1.5	4	4	4	1	3.5	3.5	90.25
8	Oxbow (big) 3 E of Davenport	Davenport	4	3	4	3	4	3	2	4	4	3	3	3	4	86
30	Oxbow 1 NE of Davenport	Davenport	4	4	4	1	3	3	2	3	3	3	3	3	3	75.5
2	Sandpit east of Fairfield	N/A	3.5	1.5	5	3.5	1	3	4	4	2.5	3.5	2.5	2.5	2.5	73
11	Oxbow 3 North of Davenport	Davenport	3	3	3	1	3	3	3	4	3.5	3	3	3	3	72.75
1A	Oxbow Reconnection (large) - NE of Ay	Ayr	2	2	3	2	4	2.5	1.5	4	2.5	4	3.5	3.5	3.5	70
9	Sandpit Wetlands	Davenport	3	3	3	1	2	3	2	3	3	3	3	3	3	68
10	Wetlands	Davenport	3	2	2	1	4	3	2	3	3	3	3	3	3	66.5
31	Oxbow 1 N of Davenport	Davenport	3	3	3	1	3	2	2	3	3	3	3	3	3	66.5
37	Oxbow large 1 N of Ayr	Ayr	3	3	3	1	3	2	2	3	3	3	3	3	3	66.5
35	Weirs Scott Creek 2NW of Ayr	Ayr	3	2	2	1	2	2	2	2	4	3	1	3	4	63

Four (4) sites for final design and construction include:

- Site 1B – Allen Small Oxbow
- Site 1C – Allen Instream Weirs
- Site 8 – Sorge Oxbow and Weir
- Site 36 – Frederick Oxbow

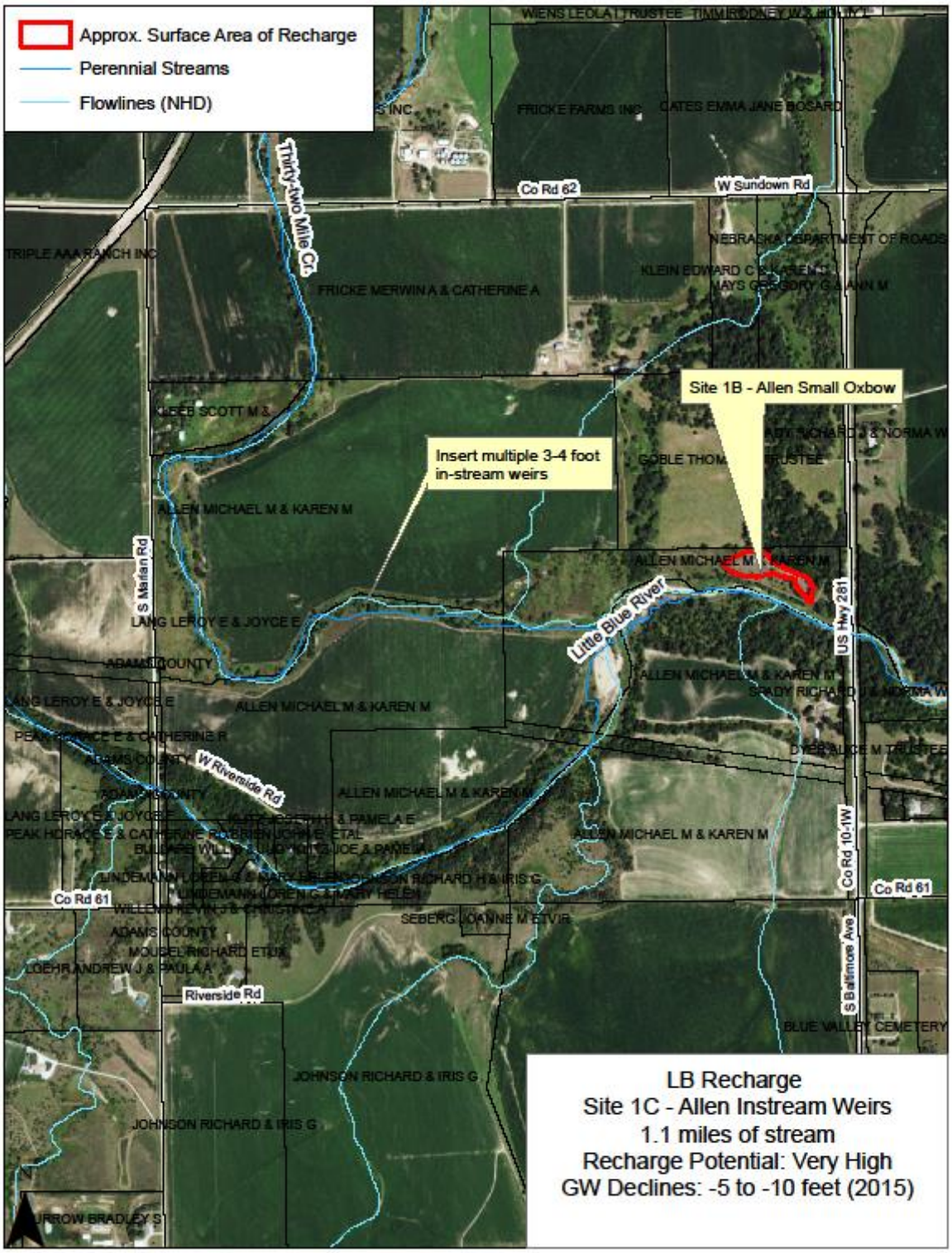
Site 1B - Allen Small Oxbow

This recharge structure consists of diverting flow from the Little Blue River to the remnant Allen Small Oxbow, see figure below. It will be accomplished by installing two (2) 36" Corrugated Metal Pipe (CMP) culverts that will divert excess flows from the river to the oxbow. This action creates a ponded area with a potential storage capacity of 8.2 acre-feet. Based upon the past ten years of gage data from the USGS Deweese Gaging Station, it is estimated that the river will rise high enough to fill the oxbow to 4.1 acre-feet on an average of three (3) times per year for a total of 12.3 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Streams
Flowlines (NHD)
S Baltimore Ave
US Hwy 281
Co Rd 10-1W
Install culverts into existing road at inlet
Thirty-two Mile Cr.
Little Blue River
N
LB Recharge
Site 1B - Allen Small Oxbow
Oxbow Reconnection (0.15 miles)
Approx. 1.9 acres surface
Recharge Potential: Very High
GW Declines: -5 to -10 feet (2015)

Site 1C - Allen Instream Weirs

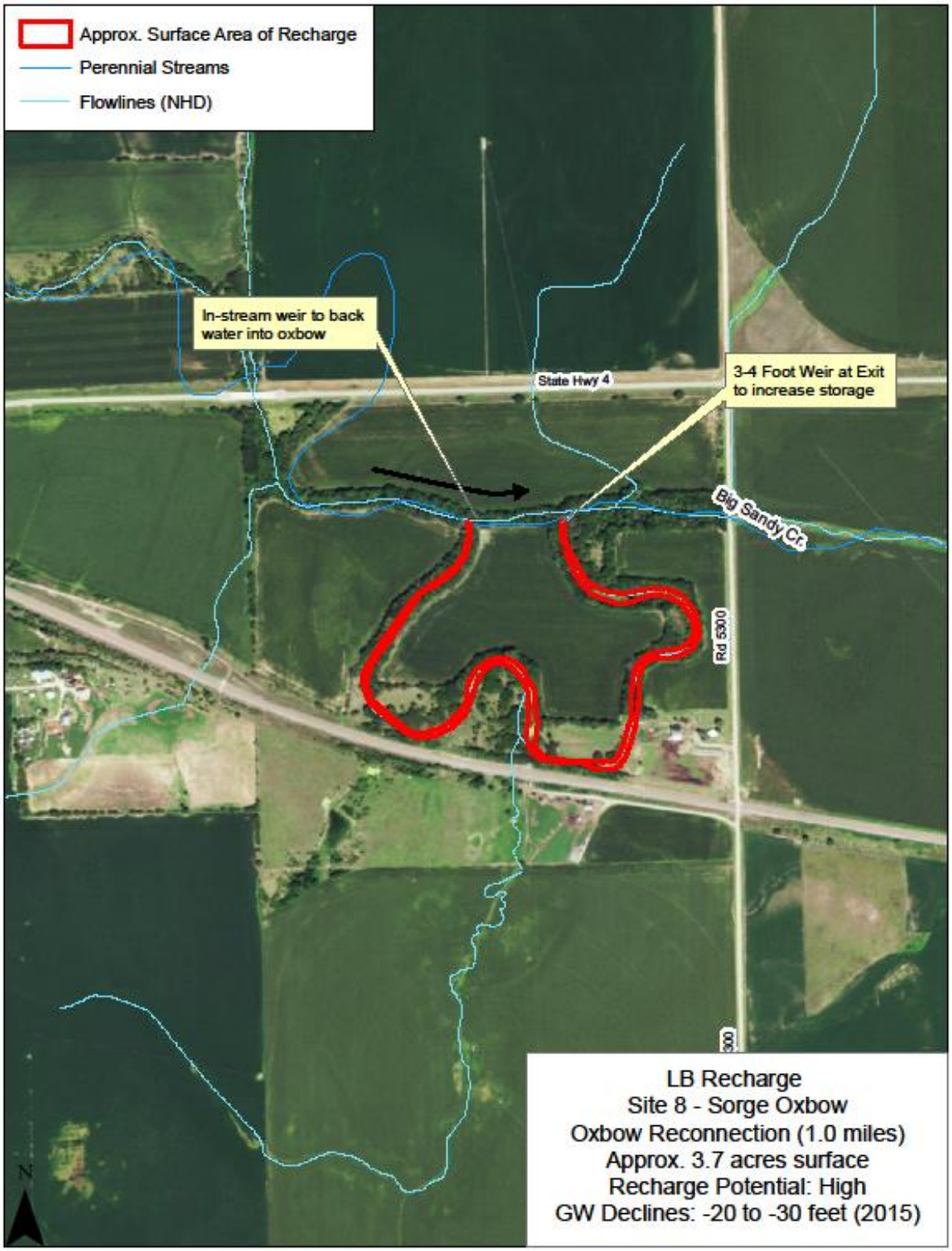
This recharge structure will include the installation of two (2) instream weirs on Thirty-Two Mile Creek, a tributary to the Little Blue River, see figure below. These weirs will be three (3) feet in height and made of rock riprap. Thirty-Two Mile Creek typically has baseflow year-round, so recharge will occur continuously from these projects. The downstream weir will be designed to inundate 0.5 acre-feet of water and the upstream weir will inundate 1.9 acre-feet. Combined these weirs would inundate 2.4 acre-feet of water with an estimated constant recharge rate of 10% per year for a total of 87.6 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Streams
Flowlines (NHD)
Thirty-two Mile Ck.
Co Rd 62
W Sundown Rd
TRIPLE AAA RANCH INC
FRICKE MERWIN A & CATHERINE A
Site 1B - Allen Small Oxbow
Insert multiple 3-4 foot in-stream weirs
ALLEN MICHAEL M & KAREN M
S Marian Rd
LANG LEROY E & JOYCE E
Little Blue River
US Hwy 281
ADAMS COUNTY
W Riverside Rd
Co Rd 61
Co Rd 10-1W
Riverside Rd
S Baltimore Ave
BLUE VALLEY CEMETERY
JOHNSON RICHARD & IRIS G
LB Recharge
Site 1C - Allen Instream Weirs
1.1 miles of stream
Recharge Potential: Very High
GW Declines: -5 to -10 feet (2015)

Site 8 - Sorge Oxbow and Weir

This recharge structure will consist of diverting flow from Big Sandy Creek into the remnant Sorge Oxbow, see figure below. This will be accomplished by installing two (2) 36-inch CMP culverts to divert flow from the creek to the oxbow. To facilitate more frequent diversions a three (3) foot tall rock weir will be installed in Big Sandy Creek, just downstream from the upper oxbow connection. A rock weir will also be installed at the downstream end of the oxbow to contain water and prevent it from reentering Big Sandy Creek. This will allow captured water to infiltrate and recharge groundwater. Finally, one smaller rock weir is anticipated within the oxbow to increase the volume of water that can be stored. It is estimated that even a minor rainfall event will cause enough rise in streamflow that the diversion will occur. It is estimated that the diversion will cause the river to rise high enough to fill the oxbow, on average, three (3) times per year for a total of 5.7 acre-feet per year. The oxbow will have a storage capacity of 1.9 acre-feet.

Big Sandy Creek typically has baseflow year-round, so recharge will occur continuously from the stream weir portion of the project. The instream weir would inundate 1.4 acre-feet of water with an estimated constant recharge rate of 10% per year for a total of 50.4 acre-feet per year.

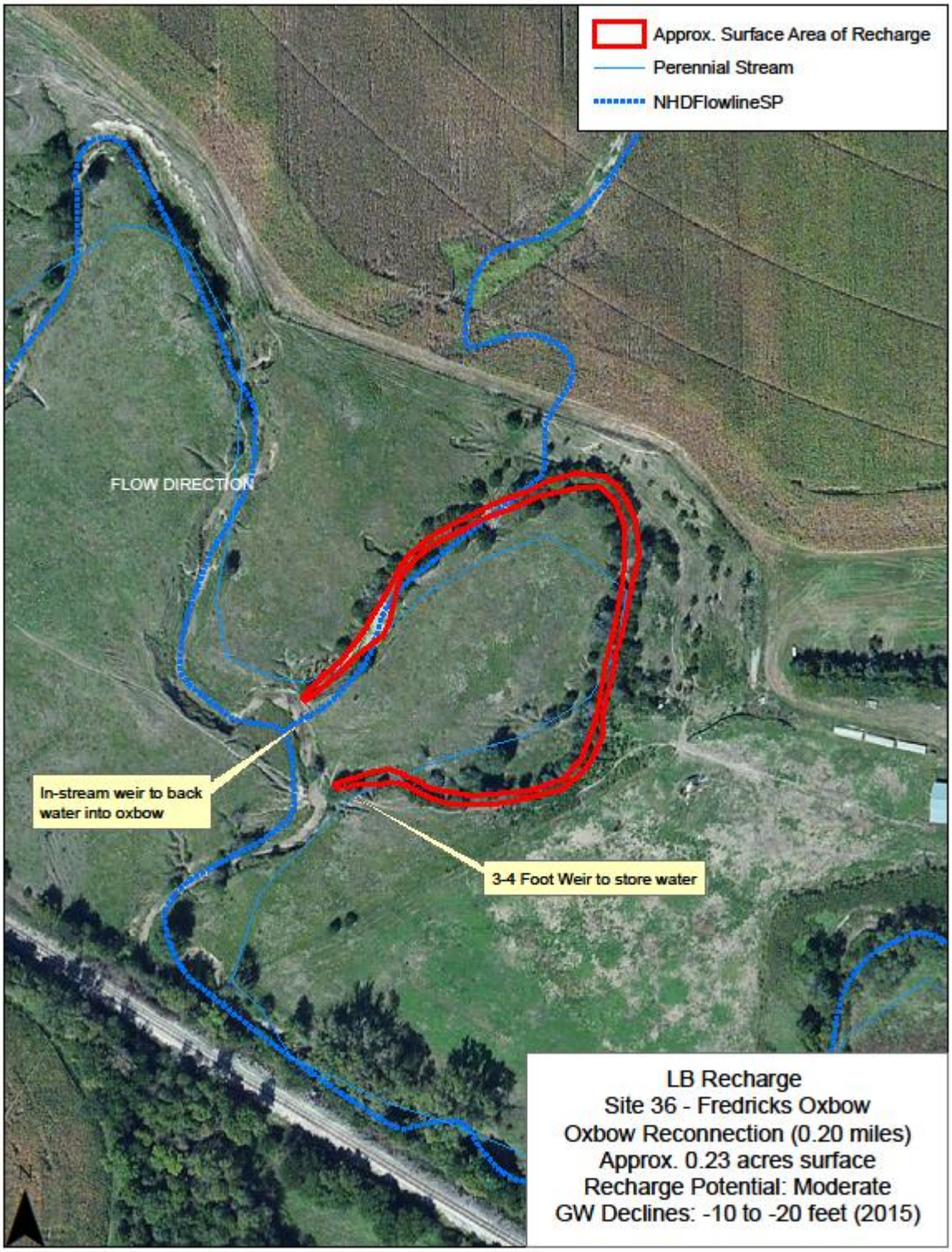

Approx. Surface Area of Recharge
Perennial Streams
Flowlines (NHD)
In-stream weir to back water into oxbow
State Hwy 4
3-4 Foot Weir at Exit to increase storage
Big Sandy Crk
Rd 5300
LB Recharge
Site 8 - Sorge Oxbow
Oxbow Reconnection (1.0 miles)
Approx. 3.7 acres surface
Recharge Potential: High
GW Declines: -20 to -30 feet (2015)

Site 36 – Fredrick Oxbow

This recharge structure will consist of diverting flow from Scott Creek into the remnant Fredrick Oxbow, see figure below. The oxbow was recently cut off from the main creek, and only about two feet of elevation difference separates the main creek from the oxbow. To increase the frequency of diversion, a two (2) foot tall rock weir will be installed in Scott Creek. A four (4) foot tall rock weir will be installed at the downstream end of the oxbow to prevent it from reentering Scott Creek. This will allow captured water to infiltrate and recharge the groundwater.

This oxbow has the ability to store 0.6 acre-feet of water. It has been estimated that five (5) runoff events of enough magnitude will occur each year to fill the oxbow. Since the oxbow has a storage capacity of 0.6 acre-feet the total annual storage for recharge will be 3.0 acre-feet per year.

Scott Creek typically has baseflow year-round, so recharge will occur continuously from the instream weir portion of the project. This weir would inundate 1.1 acre-feet of water with an estimated constant recharge rate of 10% per year for a total of 40.2 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Stream
NHDFlowlineSP
FLOW DIRECTION
In-stream weir to back water into oxbow
3-4 Foot Weir to store water
LB Recharge
Site 36 - Fredricks Oxbow
Oxbow Reconnection (0.20 miles)
Approx. 0.23 acres surface
Recharge Potential: Moderate
GW Declines: -10 to -20 feet (2015)

MONITORING

Groundwater:
The monitoring of groundwater levels at the four sites will be critical to evaluate the recharge performance. The monitoring component seeks to assess the impacts of infiltrated surface water on groundwater levels near each recharge structure. The estimated recharge to groundwater will be evaluated by estimating the volume of water that enters each structure or oxbow, infiltrates the ground, and the amount of groundwater mounding observed in proposed monitoring wells. Three (3) groundwater monitoring wells are proposed for each site, or a total of 12 wells. Data will be collected monthly by LBNRD for a total of three (3) years and information will be analyzed and reported annually. Subsequent monitoring will occur by LBNRD throughout the life of the recharge project.

Stream Erosion:
The LBNRD will visually observe the streambanks in the vicinity of the project to verify that erosion has been reduced. This inspection will occur annually. No formal surveying plan is proposed as visual inspection will be sufficient to realize the benefit.

Wetlands:
The LBNRD will visually observe the presence of wetlands created by the oxbow projects (Site 8, Site 36, and Site 1B). This can be accomplished during normal site inspections and monitoring. Additionally, it is recommended that the LBNRD track the size of wetlands each year, using aerial photography or imagery.

Stream Flow:
The amount of flood flow reduction as a result of these projects is expected to be modest. No installation of flow monitoring equipment or formal monitoring plan is proposed. Cumulatively over implementation of several projects, an observable reduction of flood flow may be realized, however individual projects will have little effect on reducing flood flows.

PROJECT COMPONENTS

Steps required for the successful implementation of a project:

- Final engineering design
  - Detailed topographic survey
  - Hydrology and hydraulics analysis
  - Final permitting
  - Design plans and specifications
- Installation of monitoring equipment
- Bidding
- Construction
- Monitoring

MAJOR PROJECT TASKS AND GENERAL TIMELINE

- Establishment of screening methodology (April – June 2017)
- Selection of 38 potential project sites (June 2017)
- Screening of project sites down to nine, site visits (July 2017)
- Conceptual site design (July 2017)
- Establishment of a monitoring plan (July 2017)
- WSF funding application (July 2017)
- Wetland delineations (August 2017)
- Obtain WSF funding (December 2017)
- Obtain all permits (January to April 2017)
- Topographic survey (January 2018)
- Final design/hydraulic modeling (March 2018)
- Installation of monitoring equipment (April to December 2018)
- Construction (May to December 2018)
- Monitoring (Ongoing)
- Operation and Maintenance (Ongoing)

A description of all field investigations made to substantiate the feasibility report (004.01 B); Click here to enter text.

Maps, drawings, charts, tables, etc., used as a basis for the feasibility report (004.01 C);

Both the Little Blue NRD Hydrogeologic Study http://www.littlebluenrd.org/hydrogeologic_study.html and the 2015 WMP http://www.littlebluenrd.org/Water/basin_water_plan.html provide detailed maps regarding the hydrogeology, land-use, irrigation development, surface water supplies, groundwater supplies, stream water quality, and other technical information. The Feasibility Study is in Appendix A

A description of any necessary water and land rights and pertinent water supply and water quality information, if appropriate (004.01 D);

Construction and access easements will be necessary for this project. Effected landowners have expressed their interest in the project and have agreed to cooperate with the LBNRD in establishing project goals and objectives and to gain further public support for the project. Once project funding is secured, the LBNRD will negotiate necessary easements with landowners for the construction and ongoing monitoring of the recharge structures**.**

A discussion of each component of the final plan including, when applicable (004.01 E);

Required geologic investigation (004.01 E 1);
The Little Blue NRD Hydro-geologic Study and the Little Blue River Basin WMP contained a significant geologic investigation of the Little Blue River Basin. Both documents can be found at: www.littlebluenrd.org. These geologic investigations included mapping the aerial extent of the aquifer, using well logs to determine aquifer properties, determine the aquifer risk to contamination, and determining areas optimal for recharge projects.

Required hydrologic data (004.01 E 2);
Water data used to determine water supplies included High Plains Regional Climate Center precipitation data, Conservation and Survey Division groundwater levels, and stream gage data provided by the Nebraska Department of Natural Resources (NDNR) and the U.S. Geological Survey (USGS). While these entities do not have data or measurement points at the proposed project sites, correlations were made to estimate water supply and availability. Other sources of water quantity and quality information were obtained from the 2015 WMP. The 2015 WMP and the Feasibility Study in Appendix A contain a detailed water budget that outlined the water supplies, water uses, and water deficits.

Since the cumulative storage impoundment capacity of each small instream structure in the river is less than 15 acre-feet and the storage capacity in the three (3) instream weirs and remnant oxbows sites will be less than 15 acre-feet, respectively, they will not require a storage permit from NDNR.

Design criteria for final design including, but not limited to, soil mechanics, hydraulic, hydrologic, structural, embankments and foundation criteria (004.01 E 3).

This project will use standard engineering design criteria and practices. The project will be designed to retain water for recharge, provide grade stabilization, and capture sediment without compromising the integrity of the stream, either up or downstream of the structures. The design will also allow water to flow over the top of the structure and continue downstream.

The recharge structures will be designed so the volume of water retained will be below the minimum threshold (15 ac-ft.) that would require a NDNR water storage permit.

The design of the recharge structures will avoid creating excessive flooding on surrounding properties. The design will seek to maximize benefits while performing within the given constraints. Designs that feature multiple, simple structures spread within the available stream present advantages over designs focusing on a few larger, more complex structures. The structures will be small and simple, avoiding the needed for complex

foundation, soil mechanics, or structural design criteria. Please see the Feasibility Study in Appendix A for a full description of design criteria.

1(b). If no (non-structural), submit data necessary to establish technical feasibility including, but not limited to the following (004.02):

A discussion of the plan of development (004.02 A);
Click here to enter text.

A description of field or research investigations utilized to substantiate the project conception (004.02 B); Click here to enter text.

A description of the necessary water and/or land rights, if applicable (004.02 C); Click here to enter text.

A discussion of the anticipated effects, if any, of the project upon the development and/or operation of existing or envisioned structural measures including a brief description of any such measure (004.02 D).
Click here to enter text.

2. Provide evidence that there are no known means of accomplishing the same purpose or purposes more economically, by describing the next best alternative.

The next best alternative to the concept of using a small instream structures and remnant oxbows for recharge and grade stabilization is the construction of a single, large reservoir. A large reservoir within the Little Blue River Basin will have significant permitting issues, will not produce basin-wide benefits, and will likely be cost-prohibitive.

Furthermore, a single reservoir will require an Individual Permit for wetlands from the U.S. Corps of Engineers, which will add significant delays and cost (perhaps several hundred thousand dollars) to the project for planning, permitting, construction, monitoring, and wetland mitigation.

Land acquisition for a large reservoir is also a major expense, compared to that required for small instream structures and remnant oxbows proposed for this project. Furthermore, public acceptance of a large reservoir can be a significant challenge. The LBNRD recently conducted a Feasibility Study for a reservoir near Davenport, but the project was postponed indefinitely due to strong public opposition.

3. Document all sources and report all costs and benefit data using current data, (commodity prices, recreation benefit prices, and wildlife prices as prescribed by the Director) using both dollar values and other units of measurement when appropriate (environmental, social, cultural, data improvement, etc.). The period of analysis for economic feasibility studies shall be fifty (50) years or with prior approval of the Director, up to one hundred (100) years [T261 CH 2 (005)].

- Describe any relevant cost information including, but not limited to the engineering and inspection costs, capital construction costs, annual operation and maintenance costs, and replacement costs. Cost information shall also include the estimated construction period as well as the estimated project life (005.01).

Relevant Cost Information
A summary of the relevant costs for project design and construction are presented in the following tables.

CONCEPTUAL Opinion of Cost
LB NRD
Recharge Projects
JEO PROJECT NO. 162076.00

Summary Table of Relevant Costs

Item No.	Item	Total
1.	Engineering	$78,000
2.	Land Rights	$7,000
3.	Capital Construction	$460,000
4.	Monitoring, Assessment	$104,700
	Total	**$649,700**

CONCEPTUAL Opinion of Cost
LB NRD
Recharge Projects
JEO PROJECT NO. 162076.00

Summary Table of Engineering Costs

Item No.	Item	Total
1.	Project Development	$58,000
2.	Final Design and Permitting	$55,395
3.	Bidding and Construction Administration	$22,410
	Total	**$135,805**

A summary of annual cost for project, Operation, Maintenance, and Replacement (OM&R) are presented in the following table.

CONCEPTUAL Opinion of Cost
LB NRD
Recharge Projects
JEO PROJECT NO. 162076.00

O&M Estimate

Item No.	Item	Unit	Quantity	Unit Price	Total
1.	Annual Operation (Staff Time)	EA	200	$500.00	$100,000
2.	Sediment and Debris Removal, Minor Repairs	EA	40	$2,000.00	$80,000
3.	Major Repair	EA	4	$10,000.00	$40,000
				Total	**$220,000**
				Average Annual Cost	$4,400

These O&M costs were generally computed following the same guidance outlined in the 2016 Feasibility Study (Appendix A).

- Only primary tangible benefits may be counted in providing the monetary benefit information and shall be displayed by year for the project life. In a multi-purpose project, estimate benefits for each purpose, by year, for the life of the project. Describe any intangible or secondary benefits separately. In a case where there is no generally accepted method for calculation of primary tangible benefits describe how the project will increase water sustainability, such that the economic feasibility of the project can be approved by the Director and the Commission (005.02).

Primary Tangible Benefits

A summary of the primary tangible benefits is included: stream stabilization, groundwater recharge, and sediment and erosion control. A summary of the annual monetary benefit of the project is presented in the following table.

CONCEPTUAL Opinion of Cost
LB NRD
Recharge Projects
JEO PROJECT NO. 162076.00

Summary of All Benefits

Item No.	Benefit	8	1B	1C	36	Total
1.	Stream Stabilization	$ 989.56	$ -	$ 1,979.12	$ 989.56	$ 3,958.24
2.	Groundwater Recharge	$5,607.00	$1,230.00	$ 8,760.00	$ 4,315.00	$ 19,912.00
3.	Sediment and Erosion	$ 750.00	$ -	$ 1,500.00	$ 750.00	$ 3,000.00
					Subtotal Annually	$26,870

These benefits were computed following the same guidance outlined in the 2016 Feasibility Study (Appendix A).

- All benefit and cost data shall be presented in a table form to indicate the annual cash flow for the life of the proposal, not to exceed 100 years (005.03).

The costs and benefits have been assessed over a 50-year lifetime as illustrated in the following cash flow table.

Cash Flow Benefit Cost
LB NRD
Recharge Projects
JEO PROJECT NO. 162076.00

Project Year	Calendar Year	Cash Flow Categories	Costs	Benefits
0.	2017.			
		Project Development Study	$ 58,000	
		Total Costs	**$ 58,000**	
		Total Benefits		$ -
1.	2018.			
		Engineering, Permitting, Construction Admin	$ 78,000	
		Land Rights	$ 7,000	
		Capital Improvement (Construction)	$ 460,000	
		Monitoring, Assessment, Outreach	$ -	
		O&M	$ 4,400	
		Land Value Benefits		$ 3,000
		Sediment/Stream Stabilization		$ 3,958
		Groundwater Recharge		$ 19,912
		Total Costs	**$ 549,400**	
		Total Benefits		**$ 26,870**
2-4	2019-2021			
		Monitoring, Assessment, Outreach	$ 104,700	
		O&M	$ 13,200	
		Land Value Benefits		$ 9,000
		Sediment/Stream Stabilization		$ 11,875
		Groundwater Recharge		$ 59,736
		Total Costs	**$ 117,900**	
		Total Benefits		**$ 80,611**
5-50	2022-2067			
		O&M	$ 202,400	
		Land Value Benefits		$ 138,000
		Sediment/Stream Stabilization		$ 182,079
		Groundwater Recharge		$ 915,952
		Total Costs	**$ 202,400**	
		Total Benefits		**$ 1,236,031**
		Total Lifetime Cost	**$ 927,700**	
		Total Lifetime Benefits		**$ 1,343,512**
		Benefit:Cost Ratio	**1.45**	

- In the case of projects for which there is no generally accepted method for calculation of primary tangible benefits and if the project will increase water sustainability, the economic feasibility of such proposal shall be demonstrated by such method as the Director and the Commission deem appropriate (005.04). Click here to enter text.

4. Provide evidence that sufficient funds are available to complete the proposal.

   The LBNRD established a Projects Sinking Fund in 2012 devoted to the development of various unspecified flood control, erosion control, and groundwater recharge projects throughout its service area. The Sinking Fund currently has $475,000 in reserve for such project development and a portion of these funds will be designated for this stabilization/recharge project.

5. Provide evidence that sufficient annual revenue is available to repay the reimbursable costs and to cover OM&R (operate, maintain, and replace).

   The LBNRDs mill levy at the time of application is $0.017706 per $100 in valuation. The maximum NRD mill levy of $0.045 per $100 of valuation. The valuation of the LBNRD is $9,334,690,475 resulting in $1,652,802 in tax revenues for District projects, activities and operations in FY2017. Based on the 2017 District valuations, the District taxing authority could generate $4,200,610 in local tax revenues. Revenues generated from local taxes will be used for all necessary operation, maintenance and replacement costs of the structure in the future.

6. If a loan is involved, provide sufficient documentation to prove that the loan can be repaid during the repayment life of the proposal.
   N/A

7. Describe how the plan of development minimizes impacts on the natural environment.

   The project and its planned development minimize impacts to the environment by utilizing small instream structures, remnant (cutoff) oxbows, and low impact water control structures. As a result, the project will have little to no negative impact on the natural environment. In fact, the remnant oxbows serve as wetlands for the portions of the year when recharge is not occurring and will continuously serve as wildlife/waterfowl habitat.

   The determination if structures are being constructed in wetlands will be made prior to the award of the construction contract. The LBNRD will not seek reimbursement for wetland delineation costs in this WSF request.

   The small instream structures will provide streambank and streambed grade stabilization, thereby reducing erosion, channel bed scour, and sediment transport. Construction will be completed by small equipment which will not require the construction of permanent roads or bridges Impacts resulting from construction activities will be temporary and minimal

Finally, one of the greatest advantages of constructing small instream structures and remnant oxbows is the minimal impact to the natural environment, compared to the impacts of a single reservoir or large dam-like structure.

The project and its planned development minimize impacts to the environment by:

- Utilizing several small structures, which have little to no impact on the larger environment, including wetlands and stream biota
- Construction can be completed by small equipment, which do not require the construction of roads or bridges; therefore, impacts will be temporary and minimal
- Structures will not be constructed in wetland areas, eliminating impacts to wetlands
- Structures perennially flowing streams will be designed to allow for fish passage.
- Allowing water to flow over the top of the small structures and continue downstream during significant rainfall events
- Designing the structures to avoid increasing negative impacts during flooding
- Stabilizing the streambed will improve the natural environment by reducing erosion and sediment transport
- Increasing habitat diversity within the stream will improve the natural environment

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds.

The LBNRD has authorities under Neb. Rev. Stat. 2-3229 for erosion prevention and control, soil conservation, and management of water supplies for beneficial uses, while Neb. Rev. Stat. 2-3230 and 2-3232 allows the NRDs to develop facilities, works, studies, and complete demonstration projects that furthers the purposes of the LBNRD. The LBNRD has the statutorily authority and jurisdiction to manage groundwater resources through the Nebraska Groundwater Management and Protection Act (Neb. Rev. Stat. 46-702, 46-703,46-704). In summary, these statutes state that NRDs have the legal authority and are the preferred regulators of groundwater quantity and quality management.

9. Explain how your project considers plans and programs of the state and resources development plans of the political subdivisions of the state.

The installation of four (4) recharge structures and monitoring equipment is a direct outcome of the 2015 WMP which was specifically written to guide development of groundwater recharge and water quality improvement projects. The 2015-WMP recognizes and utilizes the NDNR's Annual Report and Plan of Work for the Nebraska State Water Planning and Review Process (NDNR 2015 Plan). Specifically, this project meets 3 of 5 implementation focus objectives listed in the NDNR 2015 Plan:

Objective 2. Provide staff and resources to support planning and implementation of water resources projects. LBNRD has the staff to implement the WMP, including support and oversight of this project.

Objective 3. Support locally developed water management plans for managing hydrologically connected water supplies – LBNRD is in the process of writing the VIMP and established the 2015 WMP.

Objective 5. Provide coordination of federal agencies, state agencies, and local natural resources districts (NRDs), and other water interests for the development of water resources programs and projects – LBNRD is coordinating with NDNR, NRC, and NDEQ on this effort. The VIMP is being established in coordination with Tri-Basin NRD.

10. Are land rights necessary to complete your project?

YES☒ NO☐

If yes, provide a complete listing of all lands involved in the project.
Click here to enter text.

If yes, attach proof of ownership for each easements, rights-of-way and fee title currently held.
Click here to enter text.

If yes, provide assurance that you can hold or can acquire title to all lands not currently held.

The landowners of the proposed project sites have expressed interest in working with the LBNRD to meet the goals and objectives of this project. During the final design process, proper easements will be negotiated and obtained. Should a landowner no longer show interest in a project, we will work with them to adjust the project as needed to get approval. If no agreement can be made, the LBNRD will review the project ranking matrix to evaluate which of the next highest rated projects would take its place.

Although not planned for this project, the LBNRD also has the power of condemnation, if needed

11. Identify how you possess all necessary authority to undertake or participate in the project.

The LBNRD has authorities under Neb. Rev. Stat. 2-3229 for erosion prevention and control, soil conservation, and management of water supplies for beneficial uses, while Neb. Rev. Stat. 2-3230 and 2-3232 allows the NRDs to develop facilities, works, studies, and complete demonstration projects that furthers the purposes of the LBNRD. The LBNRD has the statutorily authority and jurisdiction to manage groundwater resources through the Nebraska Groundwater Management and Protection Act (Neb. Rev. Stat. 46-702, 46-703,46-704). In summary, these statutes state that NRDs have the legal authority and are the preferred regulators of groundwater quantity and quality management.

12. Identify the probable environmental and ecological consequences that may result as the result of the project.

The environmental consequences from the project are beneficial. The benefits include:

- Increased habitat diversity through creation of small ponded areas
- Increased artificial groundwater recharge and associated streamflow accretions
- Reduced streambed downcutting and streambank erosion
- Improved water quality by reducing downstream sediment transport and settling of sediment during runoff events

The proposed recharge structures are intentionally designed to be small to avoid adverse environmental impacts that are inherent with larger structures, such as negative impacts to wetlands, riparian areas, and native fish species.

Appendices and References

Appendix A. Little Blue Natural Resources District, 2016 Feasibility Study Report: Instream Weir Stabilization/Recharge Pilot Project.

Appendix B. Little Blue Natural Resources District, 2017 Prioritization Methodology Report for Groundwater Recharge, Flood Protection, and/or Oxbow Reconnection Projects.

Appendix C. Little Blue Natural Resources District, 2017 Recharge Projects Evaluation Matrix.

Little Blue Natural Resources District, 2011 Final Study Hydro-Geologic Study, http://www.littlebluenrd.org/hydrogeologic_study.html

Little Blue Natural Resources District and Tri-Basin Natural Resources District, 2015 Little Blue River Basin Water Management Plan, http://www.littlebluenrd.org/Water/basin_water_plan.html

Little Blue Natural Resources District, 2017 Little Blue & Tri-Basin NRD Voluntary Integrated Management Plans, http://jeo.com/projects/little-blue-vimp

Section C.

NRC SCORING

In the NRC's scoring process, points will be given to each project in ranking the projects, with the total number of points determining the final project ranking list.

The following 15 criteria constitute the items for which points will be assigned. Point assignments will be 0, 2, 4, or 6 for items 1 through 8; and 0, 1, 2, or 3 for items 9 through 15. Two additional points will be awarded to projects which address issues determined by the NRC to be the result of a federal mandate.

Notes:

- The responses to one criterion *will not* be considered in the scoring of other criteria. Repeat references as needed to support documentation in each criterion as appropriate. The 15 categories are specified by statute and will be used to create scoring matrixes which will ultimately determine which projects receive funding.

- There is a total of 69 possible points, plus two bonus points. The potential number of points awarded for each criteria are noted in parenthesis. Once points are assigned, they will be added to determine a final score. The scores will determine ranking.

- The Commission recommends providing the requested information and the requests are not intended to limit the information an applicant may provide. An applicant should include additional information that is believed will assist the Commission in understanding a proposal so that it can be awarded the points to which it is entitled.

Complete any of the following (15) criteria which apply to your project. Your response will be reviewed and scored by the NRC. Place an N/A (not applicable) in any that do not apply, an N/A will automatically be placed in any response fields left blank.

1. Remediates or mitigates threats to drinking water;

    - Describe the specific threats to drinking water the project will address.
    - Identify whose drinking water, how many people are affected, how will project remediate or mitigate.
    - Provide a history of issues and tried solutions.
    - Provide detail regarding long range impacts if issues are not resolved.

Drinking Water Issues and Solutions

By using small instream weirs and remnant oxbows to capture excess flows, this project will provide the benefit of recharging the groundwater, improving water quality, and restoring wetlands. These benefits will directly impact and improve drinking water. Groundwater is the source of drinking water throughout LBNRD. Unfortunately, this vital source of water is becoming stressed as groundwater levels continue to significantly decline in the area. Groundwater levels have declined almost 30 feet in some locations with declines of over 20 feet being widespread across LBNRD (See Figure below) and LBNRD, 2011 Final Study Hydro-Geologic Study,

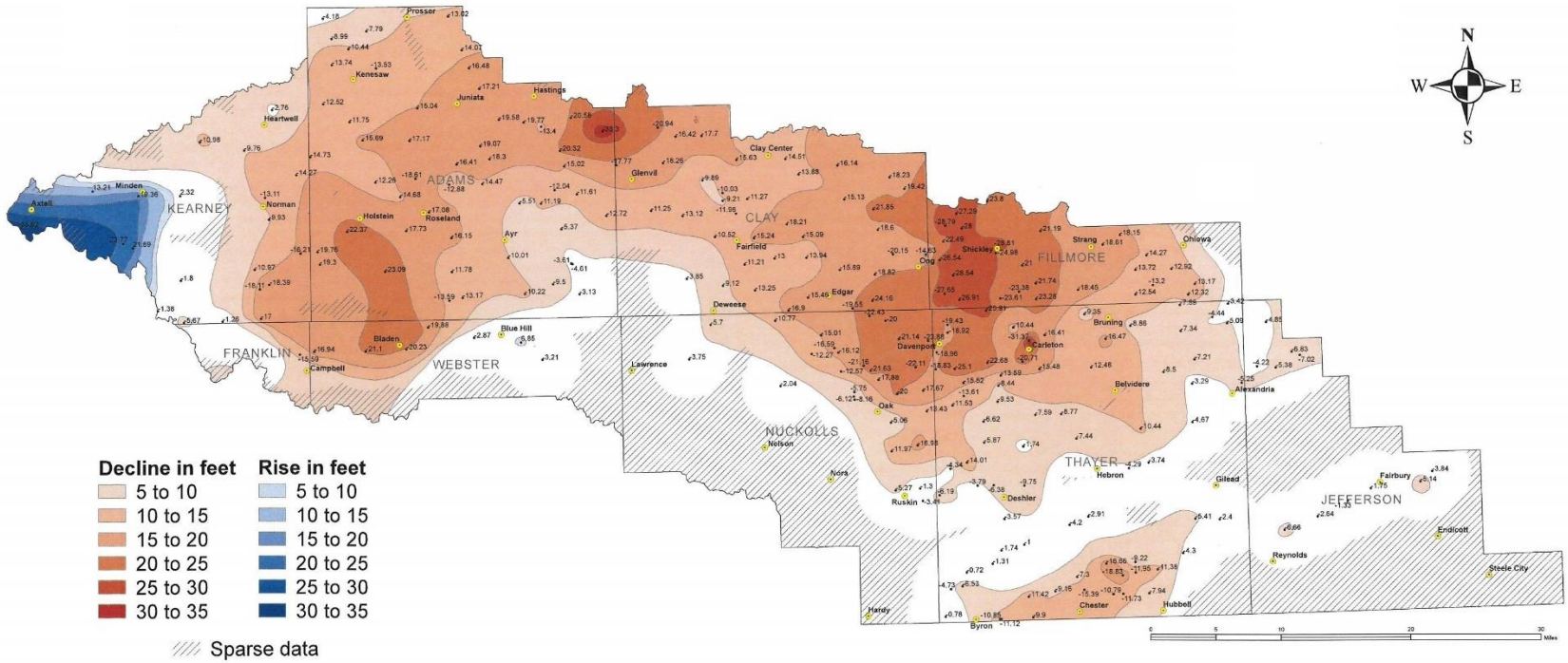
http://www.littlebluenrd.org/hydrogeologic_study.html. Wetlands provide the natural filtration process by removing sediment and pollutants out of the water, and thus preventing the contamination from reaching the groundwater. As excess flow is captured by the weir or oxbow and is stored in the wetland it infiltrates into the soil thereby naturally treating the water as it migrates to the groundwater.

Nitrates in groundwater are wide spread in LBNRD. The small instream weirs and remnant oxbows will improve water quality by reducing pollutant loadings that can and do enter the groundwater in hydrologically connected areas. By improving water quality treatment, the cost of drinking water can be reduced or eliminated. These small instream weirs and remnant oxbows have the potential to augment both surface and groundwater drinking water supplies during shortages, such as those that occurred during 2012. The drought-like conditions experienced in 2012 placed intense pressures on small domestic wells, as well as municipal water supplies throughout Nebraska and LBNRD.

In 2017, the LBNRD in cooperation with the Water Sustainability Fund began to construct small instream weirs and low-head embankment stabilization recharge projects to capture excess surface water flows. The project benefits are to recharge the groundwater, reduce flooding, protect the streambank and reduce streambed degradation, improve water quality, and create wetlands, wildlife and waterfowl habitat. A detailed description of the first phase and the associated Feasibility Study can be found in Appendix A.

Due to the extensive magnitude of these water resources problems, and ultimately the cost to remedy the situation, the LBNRD's mitigation efforts will be phased over multiple years. The first phase focused on instream weirs that partially impounded streamflow and thereby enhanced groundwater recharge. This current phase will build upon these past efforts by installing different types of recharge structures and monitoring equipment to evaluate recharge performance. Engineering designs can be modified to improve performance and the most effective technologies is deployed these selected sites. Monitoring the performance of the structures will be important so that subsequent engineering designs can be modified to improve their effectiveness.

LBNRD Groundwater-Level Changes - Predevelopment to Spring 2017



Disclaimer: this map was created using 263 plotted points, constituting the best available data as of June 9, 2017. This map is intended to provide a general overview of regional variation, not site specific conditions.

School of Natural Resources
Institute of Agriculture and Natural Resources
University of Nebraska–Lincoln

CONSERVATION AND SURVEY DIVISION (http://snr.unl.edu/csd)
School of Natural Resources (http://snr.unl.edu)
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

Aaron Young, Survey Geologist, CSD
Les Howard, GIS Manager, CSD

June 2017

U.S. Geological Survey
Nebraska Water Science Center

Upper Big Blue Natural Resource District

Tri-Basin Natural Resource District

Central Nebraska Public Power and Irrigation District

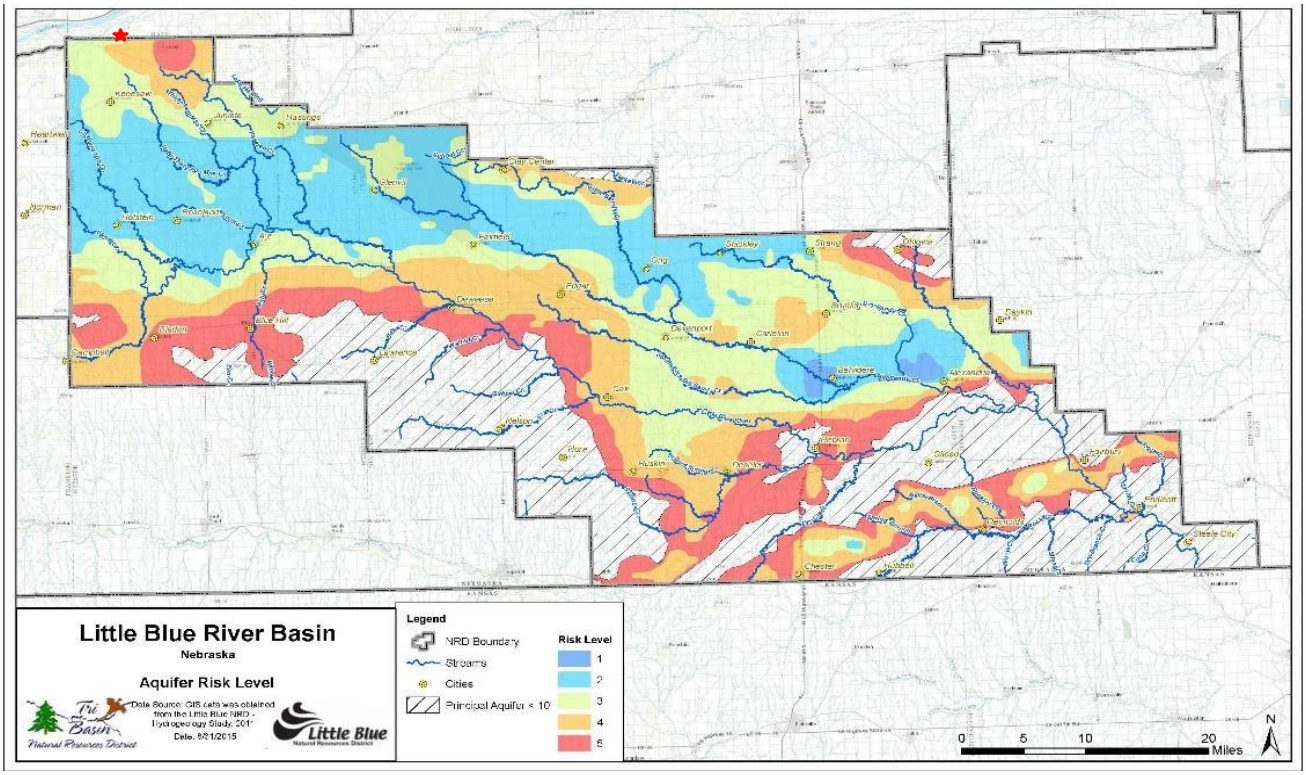
Drinking Water Effects & Mitigation

The instream weir and remnant oxbows will benefit the groundwater and streamflow by retiming flood or excess waters through artificial groundwater recharge. Drinking water in and around these project sites are provided primarily through pumping groundwater from the primary alluvial aquifer. This is true for residential wells that serve individual farmsteads and for municipal water supplies throughout the LBNRD. The primary alluvial aquifer throughout the Little Blue River Basin is large and productive and is a critical water resource; however, groundwater water declines are a serious threat to this resource. The Little Blue Basin 2015 Water Management Plan (2015 WMP) addressed this concern. The WMP can be accessed at http://www.littlebluenrd.org/Water/basin_water_plan.html. If groundwater declines continue, the long-range impacts would result in groundwater levels dropping below the screen intervals of many residential and municipal wells, placing a substantial financial burden upon individual residents and municipal governments. The LBNRD has revised the Groundwater Management Plan and has submitted it to NDNR for review.

The objective of the project is to use many small instream weirs and remnant oxbows to capture excess flows during times of high runoff and flooding and provide an opportunity to infiltrate and recharge the groundwater. While the area in the immediate vicinity of the project site will receive the direct benefit of increase recharge, these projects serve a broader objective to demonstrate the effectiveness of multiple, small- scale recharge structures. The information provided through this project will help educate the public on the importance of water sustainability and can be used as demonstration sites when encouraging other landowners across the basin to support similar recharge project on their lands. The project will also provide technical information that can with other NRDs, municipalities, and state agencies that are pursuing similar recharge concepts.

Previous Management Actions

The LBNRD has taken proactive water management actions through rules and regulations and management practices. These actions include the Hydro-Geologic Study can be assessed at, http://www.littlebluenrd.org/hydrogeologic_study.html 2015 WMP can be assessed at http://www.littlebluenrd.org/Water/basin_water_plan.html, the current development of a Little Blue & Tri-Basin Voluntary Integrated Management Plan (VIMP) can be assessed at http://jeo.com/projects/little-blue-vimp, The LBNRD has revised the Groundwater Management Plan and has submitted it to NDNR for review. These documents developed an Aquifer Risk Map (see below), designation of water quantity subareas, and other restrictions. The 2015 WMP identified groundwater recharge projects as one of the key management practices to reduce or possibly reverse trends of declining groundwater levels.



Long-Range Impacts
Artificial groundwater recharge benefits are typically long-term due to the time it takes for water to move through the unsaturated zone and into the groundwater. The long-range impacts for an individual project are not substantial, but providing numerous small instream weirs and oxbows throughout the basin could have significant and measurable impact on groundwater levels. These structures would have long-term beneficial impacts to municipal water supplies, particularly if they are located near the municipal well fields. Ultimately without this project, a critical resource, water will continue to flow out of the LBNRD and the State of Nebraska and its beneficial use will be lost.

2. Meets the goals and objectives of an approved integrated management plan or ground water management plan;

- Identify the specific plan that is being referenced including date, who issued it and whether it is an IMP or GW management plan.
- Provide the history of work completed to achieve the goals of this plan.
- List which goals and objectives of the management plan the project provides benefits for and how the project provides those benefits.

Management Plans.
The LBNRD has developing proactive water management efforts including the Little Blue River 2015 Water Management Plan (2015 WMP) and the currently under development Voluntary Integrated Management Plan (VIMP). These plans include recognizing artificial groundwater

recharge priority, development of an Aquifer Risk Map (see above), designation of water quantity subareas, and other restrictions. The 2015 WMP identified groundwater recharge projects as one of the key management practices to reduce or possibly reverse trends of declining groundwater levels.

Goals and Objectives
Little Blue River 2015 WMP, http://www.littlebluenrd.org/Water/basin_water_plan.htm

Goal #2: The NRD will achieve sustainability of water resources in the Little Blue River Basin with a better understanding of groundwater and surface water quantities, and by facilitating the implementation of projects that utilize both resources to recharge groundwater aquifers and maintain flows.

Objective: The NRD will manage water resources in a manner that will further enhance capabilities for agricultural development while maintaining necessary stream flows in the Little Blue River.

Task 1: Reduce impacts to surface water irrigators by implementing programs, projects, and actions that will increase perennial stream flows during dry periods.

Task 2: Utilize the excessive Little Blue River (and its tributaries) surface water flows to recharge groundwater aquifers within the Basin to support sustainability of irrigation and the local economy.

Task 3: Facilitate the construction of in-stream structural groundwater recharge practices.

Task 4: Recharge groundwater by utilizing excess flows by diverting water to adjacent wetlands, oxbows, and other features.

VIMP (currently under development), http://jeo.com/projects/little-blue-vimp

Goal #2: Scientifically sound, locally-based management actions to protect interconnected groundwater and surface water.

Objective 3: Identify and utilize new opportunities to increase availability of water.

- Investigate and develop water storage, groundwater recharge and augmentation projects in areas where long-term groundwater level declines exist.
- Investigate and develop cost-effective projects which capture and store storm water runoff, increase groundwater recharge, and support stream base flow.
- Support efforts to prevent invasive species which consume water resources.

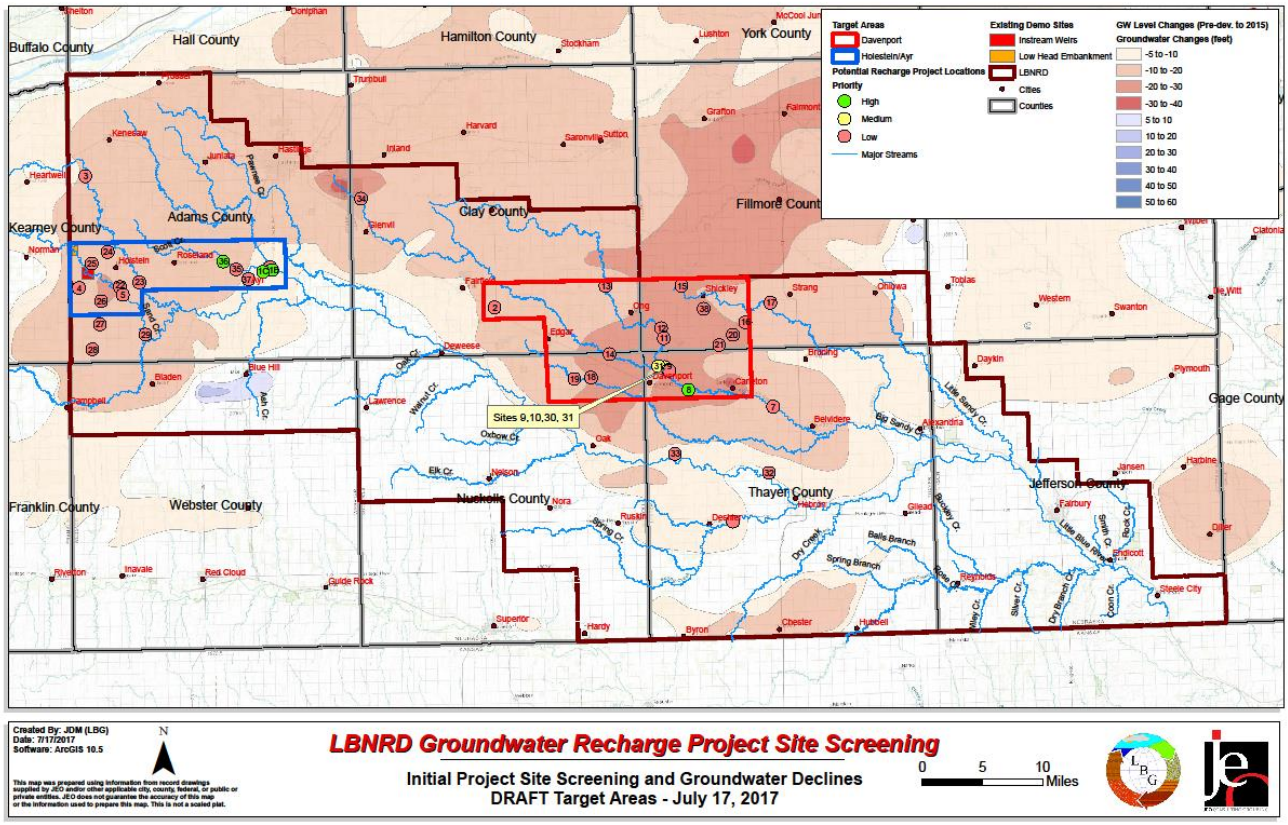
3. Contributes to water sustainability goals by increasing aquifer recharge, reducing aquifer depletion, or increasing streamflow;

   List the following information that is applicable:

- The location, area and amount of recharge;
- The location, area and amount that aquifer depletion will be reduced;
- The reach, amount and timing of increased streamflow. Describe how the project will meet these objectives and what the source of the water is;
- Provide a detailed listing of cross basin benefits, if any.

Project Locations and Screening

The small instream weir and remnant oxbow project will directly contribute to water sustainability goals by artificially recharging groundwater, thereby reducing aquifer depletion, and returning water to streams and rivers through base flow. The 38 sites were evaluated as potential project locations extending across the entire LBNRD, see below.



To assist in the selection of sites for future recharge structures, the LBNRD developed the Prioritization Methodology Report for Groundwater Recharge, Flood Protection, and/or Oxbow Reconnection Projects, June 2017 (Methodology), see Appendix B. The intent of the Methodology is to create a uniform process to screen and prioritize projects with the goal of groundwater recharge, flood reduction, streambank and streambed stabilization, water quality improvement, wetland restoration, and wildlife and waterfowl habitat creation. The Methodology created a uniform system to screen projects within targeted areas of the LBNRD that can be used each time new projects are considered. The site selection was a measured and detailed process. Multiple physical and hydrologic characteristics were examined for 38 sites to determine the best sites to achieve the project goals and for construction. The best projects are listed in the LBNRD Recharge Projects Evaluation Matrix shown below. For the complete Recharge Projects Evaluation Matrix for all 38 sites see Appendix C. Based on the Matrix, four (4) sites were selected and a conceptual project design including an initial permitting evaluation including wetland delineations have been performed.

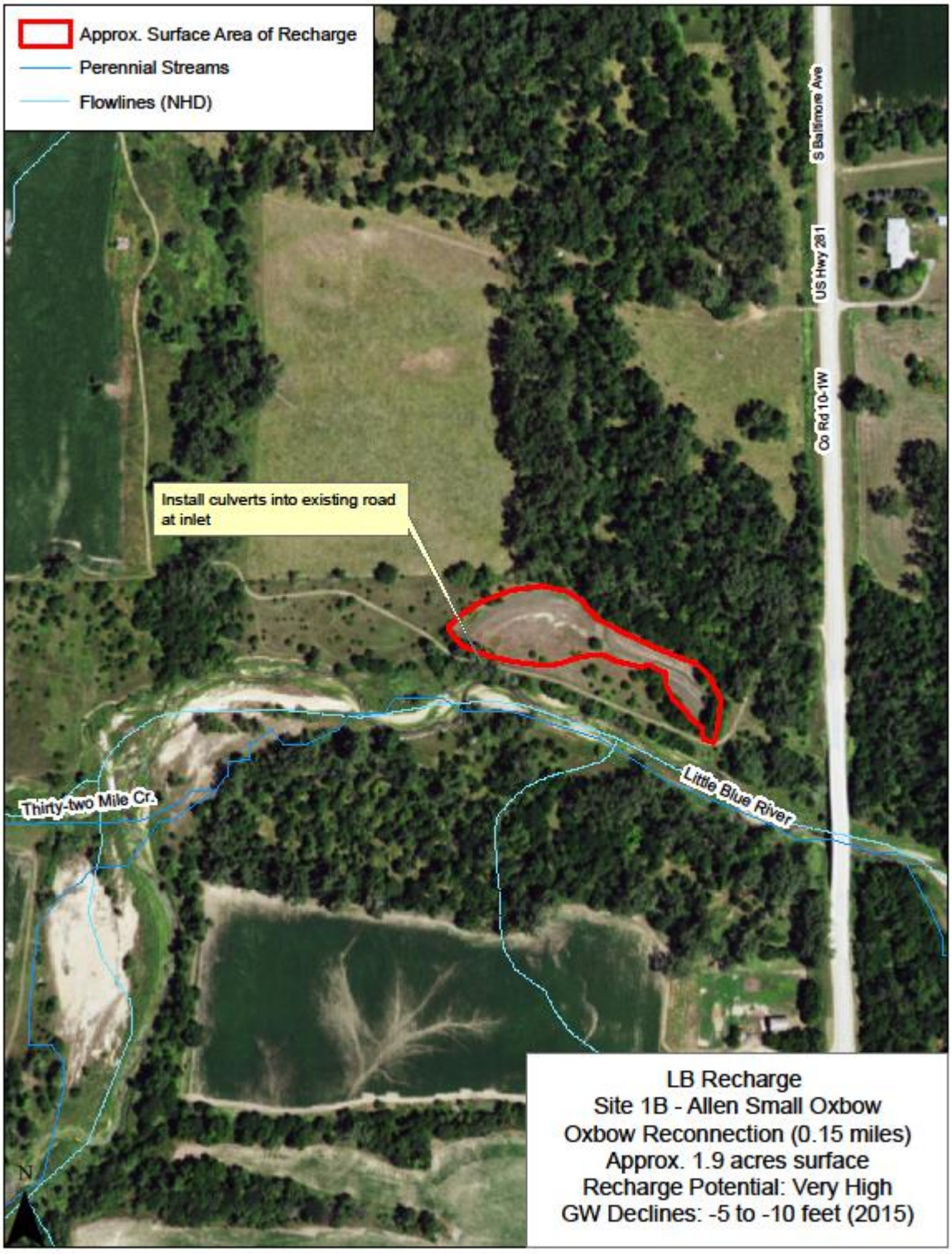
LB NRD Recharge Projects Evaluation Matrix			Technial Feasiblity	Construction Cost	Use of Existing Infrastructure	Site Access and Conditions	Aquatic Habitat Enhancement	Regulatory Implications	Groundwater Quality Impacts	Surface Water Quality Benefits	Water Source Availability	Proximity to Consumptive Uses	Flood Protection	Operation and Maintenance	Artificial Recharge Potential	Weighted Score
		Weighting Factor	*3*	*3*	*1*	*3*	*1*	*3*	*1*	*2*	*3*	*2*	*2*	*2*	*3*	125
Project #	**Project Name**	**Target Area**														
1B	Oxbow Reconnection (small) - NE of Ay	Ayr	3	5	4	5	4	4	1.5	4	4	4	2.5	3.5	4	96.5
36	Oxbow/weirs 3 NW of Ayr	Ayr	5	4	4	4	4	3	2	3	4	3	3	3	4	92.5
1C	In-stream Weirs - NE of Ayr	Ayr	3	4	4	5	4	4	1.5	4	4	4	1	3.5	3.5	90.25
8	Oxbow (big) 3 E of Davenport	Davenport	4	3	4	3	4	3	2	4	4	3	3	3	4	86
30	Oxbow 1 NE of Davenport	Davenport	4	4	4	1	3	3	2	3	3	3	3	3	3	75.5
2	Sandpit east of Fairfield	N/A	3.5	1.5	5	3.5	1	3	4	4	2.5	3.5	2.5	2.5	2.5	73
11	Oxbow 3 North of Davenport	Davenport	3	3	3	1	3	3	3	4	3.5	3	3	3	3	72.75
1A	Oxbow Reconnection (large) - NE of Ay	Ayr	2	2	3	2	4	2.5	1.5	4	2.5	4	3.5	3.5	3.5	70
9	Sandpit Wetlands	Davenport	3	3	3	1	2	3	2	3	3	3	3	3	3	68
10	Wetlands	Davenport	3	2	2	1	4	3	2	3	3	3	3	3	3	66.5
31	Oxbow 1 N of Davenport	Davenport	3	3	3	1	3	2	2	3	3	3	3	3	3	66.5
37	Oxbow large 1 N of Ayr	Ayr	3	3	3	1	3	2	2	3	3	3	3	3	3	66.5
35	Weirs Scott Creek 2NW of Ayr	Ayr	3	2	2	1	2	2	2	2	4	3	1	3	4	63

Four (4) sites for final design and construction include:

- Site 1B – Allen Small Oxbow
- Site 1C – Allen Instream Weirs
- Site 8 – Sorge Oxbow and Weir
- Site 36 – Frederick Oxbow

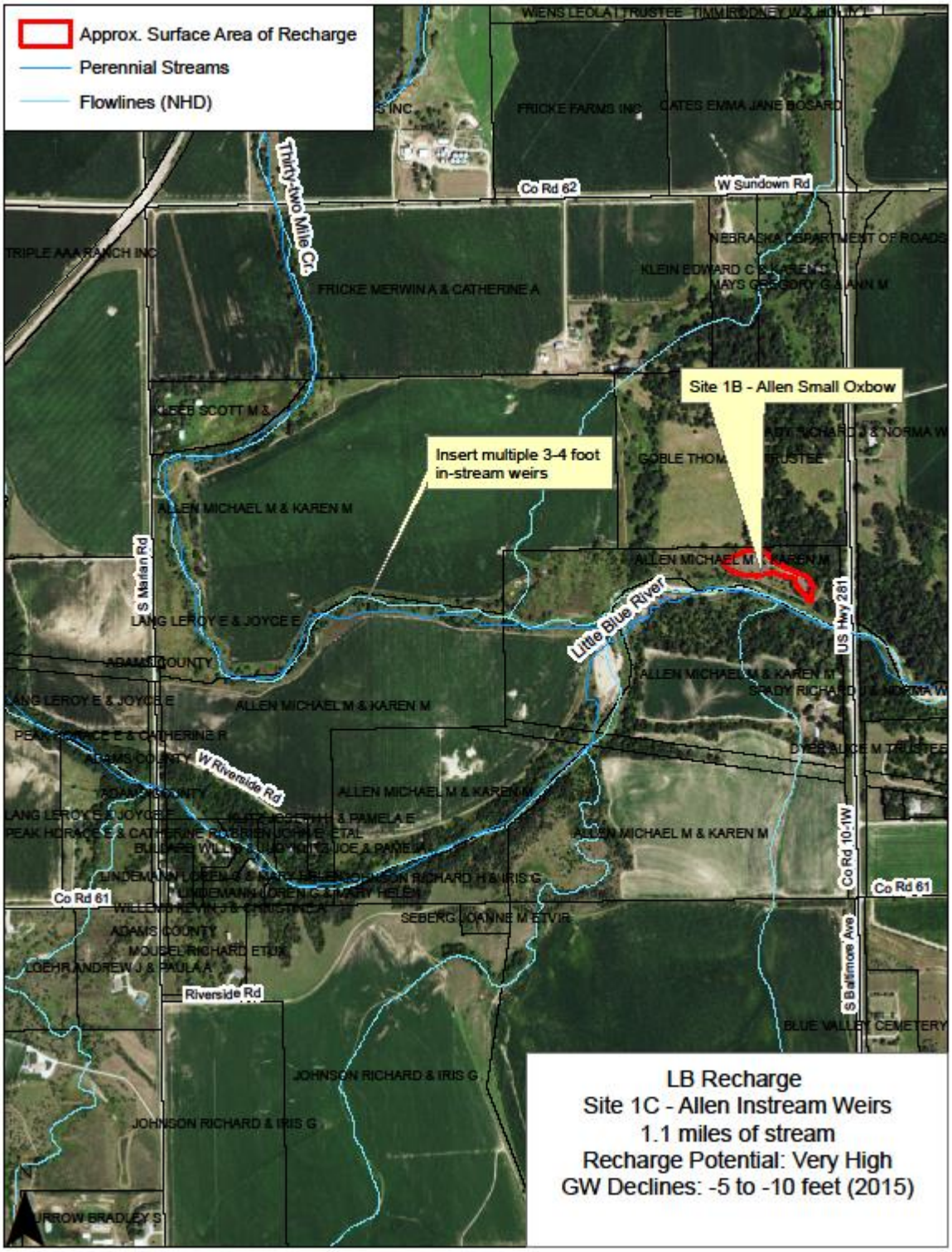
Site 1B - Allen Small Oxbow

This recharge structure consists of diverting flow from the Little Blue River to the remnant Allen Small Oxbow, see figure below. It will be accomplished by installing two (2) 36” Corrugated Metal Pipe (CMP) culverts which will divert excess flows from the river to the oxbow. This action creates a ponded area with a potential storage capacity of 8.2 acre-feet. Based upon the past ten (10) years of gage data from the USGS Deweese Gaging Station, it is estimated that the river will rise high enough to fill the oxbow to 4.1 acre-feet on an average of three (3) times per year for a total of 12.3 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Streams
Flowlines (NHD)
S Baltimore Ave
US Hwy 281
Co Rd 10-1W
Install culverts into existing road at inlet
Thirty-two Mile Cr.
Little Blue River
N
LB Recharge
Site 1B - Allen Small Oxbow
Oxbow Reconnection (0.15 miles)
Approx. 1.9 acres surface
Recharge Potential: Very High
GW Declines: -5 to -10 feet (2015)

Site 1C - Allen Instream Weirs

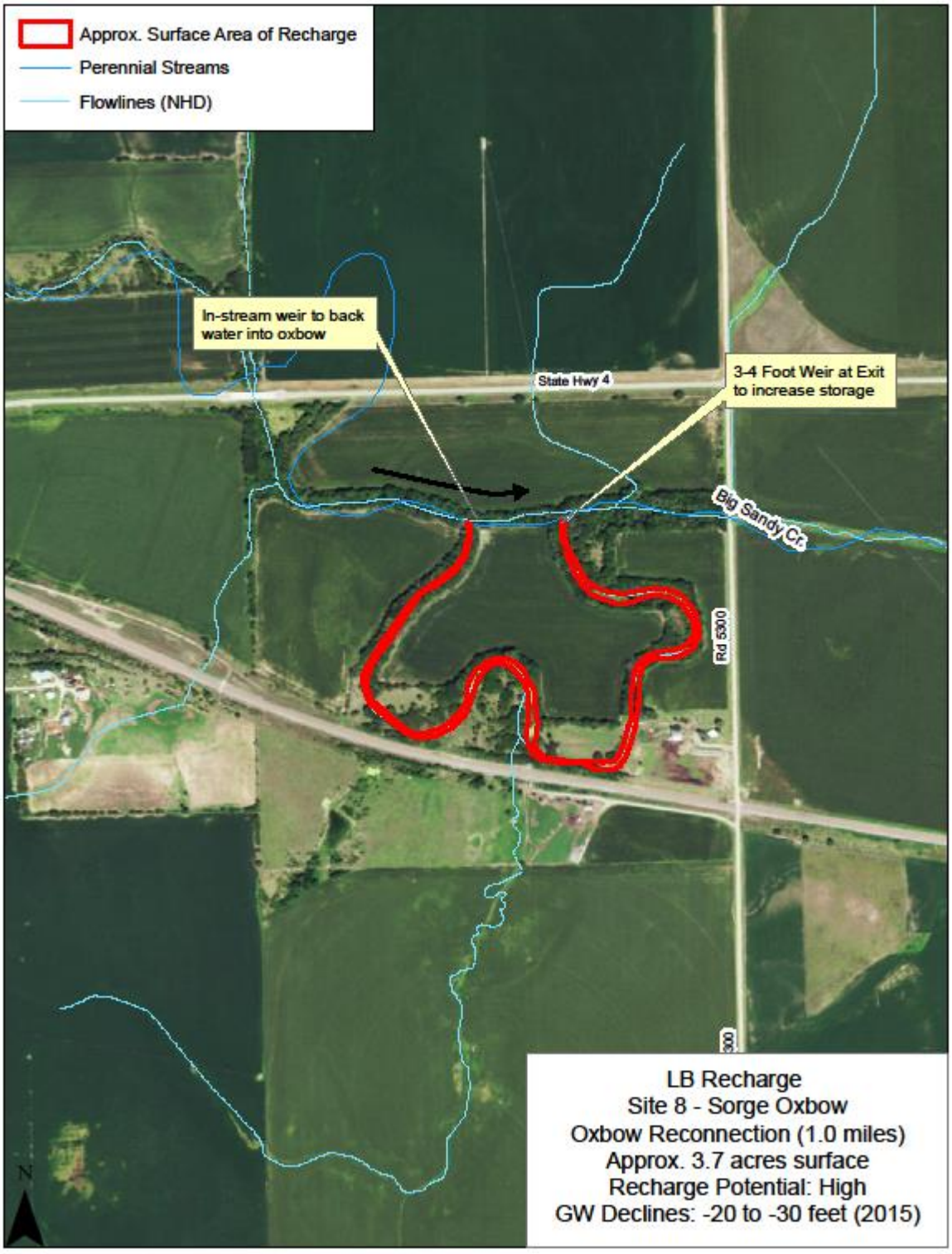
This recharge structure will include the installation of two (2) instream weirs on Thirty-Two Mile Creek, a tributary to the Little Blue River, see figure below. These weirs will be three (3) foot in height and made of rock riprap. Thirty-Two Mile Creek typically has baseflow year-round, so recharge will occur continuously from these projects. The downstream weir will be designed to inundate 0.5 acre-feet of water and the upstream weir will inundate 1.9 acre-feet. Combined these weirs would inundate 2.4 acre-feet of water with an estimated constant recharge rate of 10% per year for a total of 87.6 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Streams
Flowlines (NHD)
Thirty-two Mile Ct.
Co Rd 62
W Sundown Rd
FRICKE FARMS INC
CATES EMMA JANE BOSARD
TRIPLE AAA RANCH INC
FRICKE MERWIN A & CATHERINE A
KLEIN EDWARD C & KAREN D
Site 1B - Allen Small Oxbow
Insert multiple 3-4 foot in-stream weirs
ALLEN MICHAEL M & KAREN M
S Marlan Rd
LANG LEROY E & JOYCE E
Little Blue River
US Hwy 281
ADAMS COUNTY
W Riverside Rd
Co Rd 10-1W
Co Rd 61
SEBERG JOANNE M ETVIR
MOUSEL RICHARD ETUX
Riverside Rd
S Baltimore Ave
BLUE VALLEY CEMETERY
JOHNSON RICHARD & IRIS G
LB Recharge
Site 1C - Allen Instream Weirs
1.1 miles of stream
Recharge Potential: Very High
GW Declines: -5 to -10 feet (2015)

Site 8 - Sorge Oxbow and Weir

This recharge structure will consist of diverting flow from Big Sandy Creek into the remnant Sorge Oxbow, see figure below. This will be accomplished by installing two (2) 36-inch CMP culverts to divert flow from the creek to the oxbow. To facilitate more frequent diversions, a three (3) foot tall rock weir will be installed in Big Sandy Creek just downstream of the upper oxbow connection. A rock weir will also be installed at the downstream end of the oxbow to contain water and prevent it from reentering Big Sandy Creek. This will force captured water to infiltrate and recharge groundwater. Finally, a smaller rock weir is anticipated within the oxbow to increase the volume of water that can be stored. It is estimated that even a minor rainfall event will cause enough rise in streamflow that the diversion will occur. It is estimated that the diversion will cause the river to rise high enough to fill the oxbow, on average, three (3) times per year for a total of 5.7 acre-feet per year. The oxbow will have a storage capacity of 1.9 acre-feet.

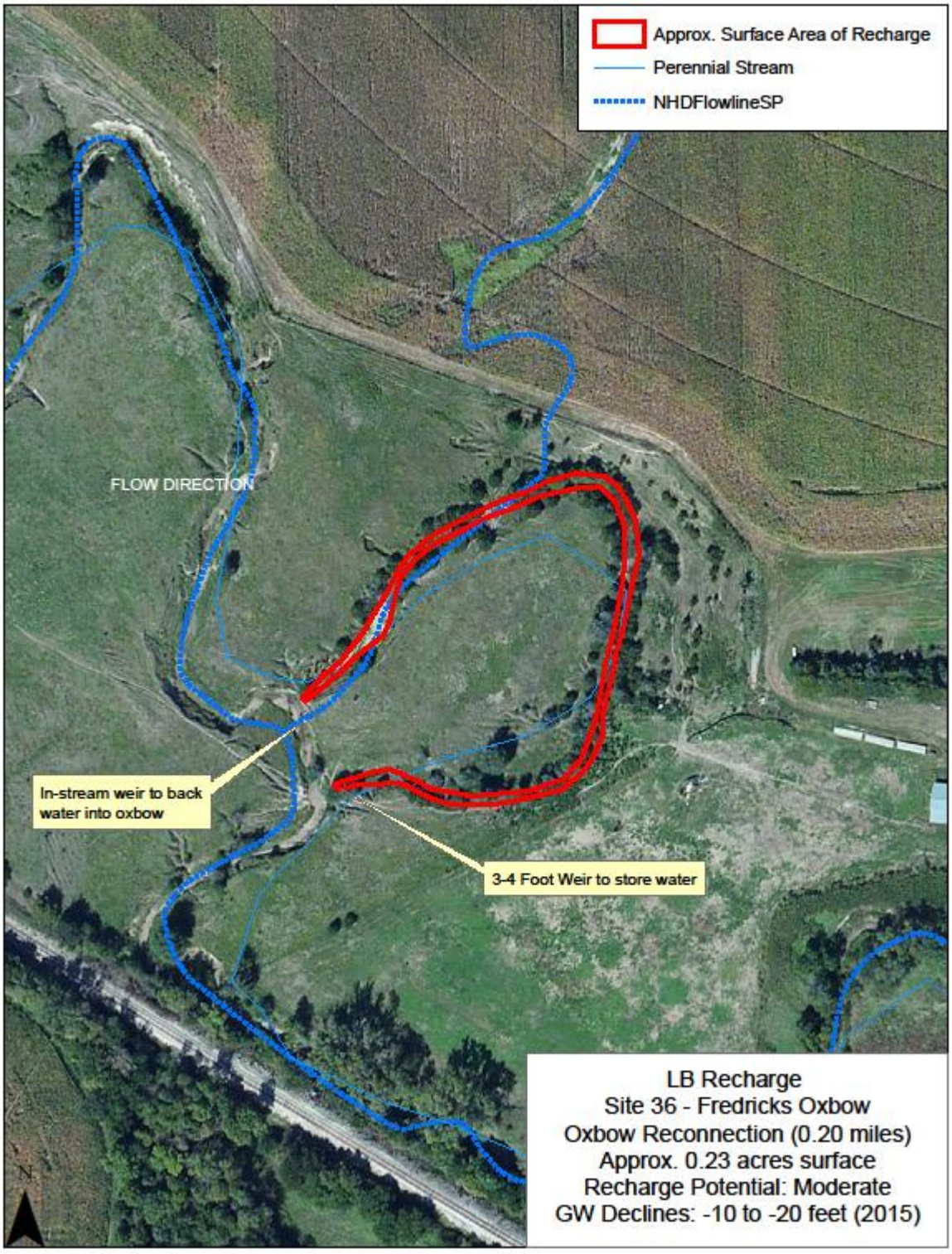
Big Sandy Creek typically has baseflow year-round, so recharge will occur continuously from the instream weir component of the project. This weir would inundate 1.4 acre-feet of water with an estimated constant recharge rate of 10% per year for a total of 50.4 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Streams
Flowlines (NHD)
In-stream weir to back water into oxbow
3-4 Foot Weir at Exit to increase storage
State Hwy 4
Big Sandy Cr.
Rd 5300
LB Recharge
Site 8 - Sorge Oxbow
Oxbow Reconnection (1.0 miles)
Approx. 3.7 acres surface
Recharge Potential: High
GW Declines: -20 to -30 feet (2015)
N

Site 36 – Fredrick Oxbow

This recharge structure will consist of diverting flow from Scott Creek into the remnant Fredrick Oxbow, see figure below. The oxbow was recently cut off from the main creek and only about two feet of elevation difference separates the main creek from the oxbow. To increase the frequency of diversion, a two (2) foot tall rock weir will be installed in Scott Creek. A four (4) foot tall rock weir will be installed at the downstream end of the oxbow to prevent it from reentering Scott Creek, allowing it to infiltrate and recharge the groundwater. This oxbow has the capacity to store 0.6 acre-feet of water. It has been estimated that five (5) runoff events of enough magnitude will occur each year to fill the oxbow. Since the oxbow has a storage capacity of 0.6 acre-feet, the total annual storage for recharge will be 3.0 acre-feet per year.

Scott Creek typically has baseflow year-round, so it can reasonably be assumed that recharge would occur continuously from the instream weir component of the project. This weir would inundate 1.1 acre-feet of water with an estimated constant recharge rate of 10% per year for a total of 40.2 acre-feet per year.


Approx. Surface Area of Recharge
Perennial Stream
NHDFlowlineSP
FLOW DIRECTION
In-stream weir to back water into oxbow
3-4 Foot Weir to store water
LB Recharge
Site 36 - Fredricks Oxbow
Oxbow Reconnection (0.20 miles)
Approx. 0.23 acres surface
Recharge Potential: Moderate
GW Declines: -10 to -20 feet (2015)

Aquifer Benefits
The 2015 WMP recommends a long-term target of 35,000 acre-feet increased annual recharge throughout the Little Blue Basin. This target was established based the estimated annual aquifer depletion.

Once constructed, the instream weirs will backup of water for each runoff event and divert flow into the remnant oxbows or impound water behind the weir. Most of the water held back by the instream weirs will infiltrate through the sandy substrate to the aquifer. On average, the area typically receives 28 inches of precipitation, resulting from approximately 3-5 runoff producing storm events per year (data from High Plains Regional Climate Center). Recharge is estimated at approximately 199 acre-feet per year from the 4 projects. This groundwater recharge from this project will be directly help reduce areas where there are significant groundwater declines. Monitoring data will help guide and improve future recharge projects to further reduce the aquifer depletion across LBNRD.

Stream Benefits
The 2015 WMP identified and described the long-term decreasing in streamflow in the basin directly associated with the corresponding decreases in groundwater levels in the primary aquifer. The source of the water is excess water during surface runoff events that would normally flow down the River into Kansas. This project will help capture a portion of the excess flows and prevent from leaving the State of Nebraska. Excess flows will artificially recharge groundwater and eventually result in increased baseflow. The baseflow will be retimed so it will be available as streamflow during key times, such as needed for Blue River Compact compliance, instead of flowing out of the Little Blue Basin during periods of excess runoff. After construction of the four structures, the monitoring protocol will include methods to estimate the quantity of water that recharges the groundwater, retained by the structures and the volume of water that recharges the aquifer.

Basin-Wide Benefits
Implementation of larger-scale projects is quite difficult, as land rights, permitting, and construction costs often lead to non-feasible projects. Whereas numerous small-scale projects are often easier to permit and fund due to smaller adverse environmental impacts. Properly placed and designed small-scale projects can provide significant benefits to the hydrologic system over large geographic areas of the basin. The recharge benefit from a single diversion event or structure will not be large, but the intent is to prove through this pilot project that small-scale recharge projects do benefit the aquifer and augment streamflow. Successful implementation of this project will lead to other similar projects throughout the basin, where the cumulative benefits may be substantially larger. Ultimately without this project, a critical resource, water will continue to flow out of the LBNRD and the State of Nebraska and its beneficial use will be lost.

4. Contributes to multiple water supply goals, including, but not limited to, flood control, agricultural use, municipal and industrial uses, recreational benefits, wildlife habitat, conservation of water resources, and preservation of water resources;

- List the goals the project provides benefits.
- Describe how the project will provide these benefits
- Provide a long-range forecast of the expected benefits this project could have versus continuing on current path.

Project Goals
The small instream weir and remnant oxbow project will contribute to multiple water supply goals, including municipal use, agricultural use, improved water quality, increased wetland restoration, creation of wildlife and water fowl habitat, preservation of water resources, stream baseflow augmentation, and improved flood control.

Project Benefits
The project will provide benefits related to helping sustain a reliable, high-quality water supply for residential, municipal, agricultural, industrial use by the following benefits and actions:

- Groundwater Recharge. Remnant oxbows and small instream weirs will be engineered to store excess flows that will infiltrate and recharge groundwater.
- Flood Reduction. Flood flows will be diverted into oxbows that will provide off-channel storage that reduces the peak of the flood flows.
- Streambank and Streambed Stabilization. Reducing peak flows will help prevent scour on the banks and in the channel. The instream weir will also provide grade control thereby reducing sediment loadings.
- Water Quality Improvement. Reducing peak flows will help prevent mobilization of sediment and other water quality impairments. Oxbows will also capture pollutants in runoff from adjacent fields.
- Wetlands Restoration and Wildlife and Waterfowl Habitat Creation. Shallow standing water in the oxbows will restore wetlands and provide excellent habitat for wildlife and waterfowl.

The increased groundwater recharge will help preserve water resources by diverting and storing excess flows water during low use periods to artificially recharge the groundwater. Over time, the recharged groundwater will return to the streams and river as baseflow. Successful implementation of this project would lead to other numerous small projects that, cumulatively, could have meaningful impacts to the streams and aquifer.

The project will provide some flood control by providing a small amount of increased storage and increased infiltration in the upper reaches of the watershed. This is the same concept applied to ‘green infrastructure’ strategies to improvement management of stormwater runoff in urban settings. Green infrastructure strategies

have proven that the many small improvements that provide additional storage and infiltration through a watershed can result in substantial decreases in the peak flow and volume in lower reaches during flood events. This project applies the same general strategy of green infrastructure, but at much larger scale within the rural setting.

Restoring wetlands will provide the natural filtration process by removing sediment and pollutants out of the water, and thus preventing the contamination from reaching the groundwater. As excess flow is captured by the weir or oxbow and is stored in the wetland and infiltrates into the soil thereby naturally treating the water as it migrates to the groundwater. Nitrates in groundwater are wide spread in LBNRD. The small instream weirs and remnant oxbows will improve water quality by reducing pollutant loadings that can and do enter the groundwater in hydrologically connected areas. By improving water quality treatment, the cost of drinking water can be reduced or eliminated. The project will provide benefits related to water quality by stabilizing the stream banks and reducing bed degradation reducing sediment. This will minimize erosion in the streambed and stream banks reducing sediment transport downstream. The instream structures will also help settle and trap sediment upstream of the structures. Naturally, the water quality improvements will provide benefits to the wildlife. The temporary ponded areas will also provide increased habitat diversity for wildlife species.

Future Without Project
Without this project, the above long-term benefits would not exist. Groundwater declines will continue, wetlands will not be restored, water quality will continue to degrade, streambank and streambed erosion and scour will continue. Ultimately without this project, a critical resource, water will continue to flow out of the LBNRD and the State of Nebraska and its beneficial use will be lost.

5. Maximizes the beneficial use of Nebraska's water resources for the benefit of the state's residents;

    - Describe how the project will maximize the increased beneficial use of Nebraska's water resources.
    - Describe the beneficial uses that will be reduced, if any.
    - Describe how the project provides a beneficial impact to the state's residents.

Project Beneficial Uses
The instream weir and remnant oxbow project will help maximize use of Nebraska's water resources by conserving water and preventing it from flowing out of the LBNRD and the State of Nebraska thereby losing its beneficial use.

Water supply projects cannot increase the total volume of available water, but these types of projects can store and retime the water from times of excess to times of need. The instream weir will retime excess stream flows by ponding water and directing flow

into remnant oxbows that will recharge the groundwater, reduce groundwater declines, and provide long-term streamflow benefits. This will help maximize the beneficial use of Nebraska's water by Nebraskans, particularly junior surface water users that frequently face administration for compliance with the Little Blue River Compact with the State of Kansas.

Adverse Impacts
This project will not reduce streamflow or aquifer benefits for any user or group of users. No opposition to these projects is known.

State Benefits
The project provides a benefit to the state's residents by implementing cost-effective, environmentally-friendly, and small-scale projects that will not adversely impact land-owners or rely upon regulations to address groundwater declines and streamflow depletions. The benefits will extend far beyond the immediate vicinity of the project site. The projects will increase stream baseflow, particularly during periods where water use exceeds supplies. The information gathered from monitoring the projects will help educate the public on the importance of water sustainability and can be used as demonstration sites when encouraging other landowners across the LBNRD service area to support similar recharge project on their lands. This information will be valuable to the LBNRD, but will also be shared with other NRDs, municipalities, and state agencies that are pursuing similar recharge concepts.

6. Is cost-effective;

- List the estimated construction costs, O/M costs, land and water acquisition costs, alternative options, value of benefits gained.
- Compare these costs to other methods of achieving the same benefits.
- List the costs of the project.
- Describe how it is a cost effective project or alternative.

List the Estimated Project Costs:

• Engineering and Construction:	$538,000
• Annual Operation and Maintenance Costs:	$ 4,400
• Land Acquisition Costs:	$ 7,000
• Monitoring, Assessment, and Outreach:	$104,700

Compare these costs to other methods:
The other alternatives to promote recharge in the region generally include dams or berms to impound water. A typical small farm pond can cost at least $100,000 including engineering, permitting, and construction. A larger dam on the main creeks that these proposed projects are located on can cost upwards of hundreds of thousands of dollars, or more. Additionally, these alternatives are much more difficult to site due to much larger footprints and are unlikely to be feasible options in our proposed locations.

List the Costs of the project:
More detailed breakdowns of the estimated construction costs can be found in the Appendix D

Describe how it is cost effective:
These projects have many design considerations to maximize cost-effectiveness, including:

- Create structures which provide multiple benefits such as recharge, stream stabilization, sediment and water quality improvements, restoration of wetlands and habitat creation
- Provide easy to maintain structures in areas that may not otherwise be conducive to larger more complex structures.
- Optimize storage potential while minimizing needs for permits
- Minimize construction cost
- Provide a monitoring program to truly analyze benefits of the project
- Provide secondary benefits to landowners, such as stream crossings, reduce bank erosion, and increased habitat
- Share and distribute information gathered from the project
- Avoid adverse effects caused by the project such as flooding or stream instability

The direct value of the estimated annual benefits gained in the direct vicinity of the site are $26,870 per year or $1,343,500 over 50 years. The proposed monitoring plan has been developed to gain a more accurate understanding of the true benefits of the project so that benefit cost calculations can be more refined for similar projects in the future.

The project has an estimated cost-benefit ratio of: 1.45

7. Helps the state meet its obligations under interstate compacts, decrees, or other state contracts or agreements or federal law;

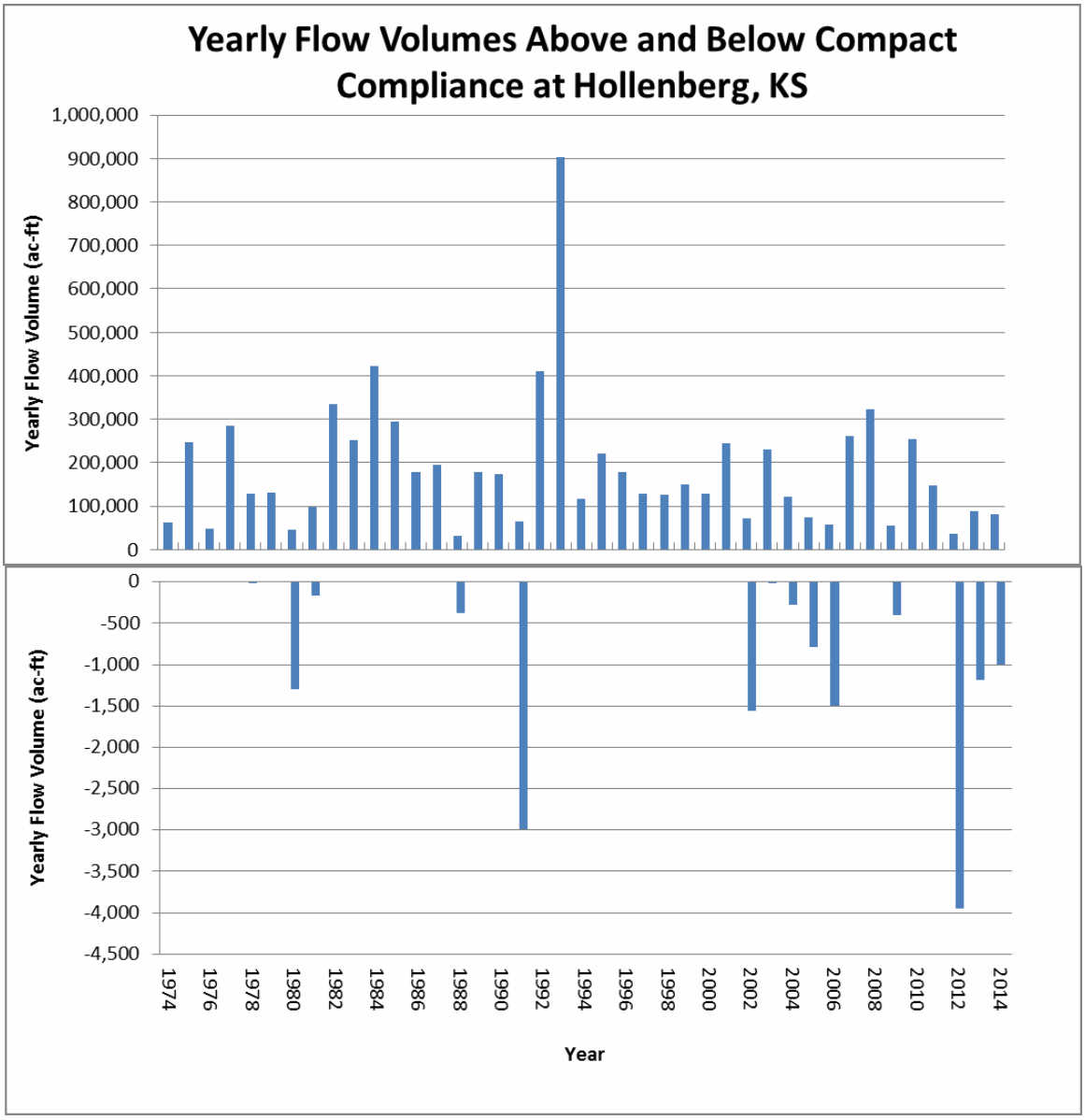
- Identify the interstate compact, decree, state contract or agreement or federal law.
- Describe how the project will help the state meet its obligations under compacts, decrees, state contracts or agreements or federal law.
- Describe current deficiencies and document how the project will reduce deficiencies.

Interstate Compact
The instream weir and remnant oxbow project will help meet State of Nebraska compliance with the interstate compact on the Little Blue River, while reducing adverse impacts to junior surface water appropriators.

Compact Compliance: The State of Nebraska signed an interstate compact on the Little Blue River in 1971. The flow requirements are 45 cubic feet per second (cfs) in May and June 75 cfs in July 80 cfs in August, and 60 cfs in September. There are no minimum flow requirements for October through April. The Hollenberg streamgage is the measuring point. If stream flows fall below the Compact minimum flow requirements, the NDNR implements water rights administration actions regarding surface water irrigators within the Basin. There are 244 water rights for surface water irrigation and 129 storage water rights within the Basin; 111 of the water rights and all of the storage water rights are administered for Compact compliance. Administration, or 'shutting off' these junior surface water users allows the state to remain in compliance, but has significant adverse impacts to those junior irrigators.

Current Deficiencies: Currently and historically, the State of Nebraska maintains and complies with its provisions of the interstate compact with the State of Kansas. However, junior surface water irrigators frequently face administration due to insufficient streamflow to fully meet all demands. Daily flow requirements were met at the Hollenberg gage during the compliance period (May 1st to September 30th) in all but 4 years between 1971 and 2002. However, during the period of 2000-2016, 11 of the 16 years had flows falling below the compliance requirements, and an increase in the frequency of water rights administration. The increase in administration necessary for Compact compliance is highlighted in the gage results from 2012. Stream flows were unusually low during 2012, as shown in the Figure below. The daily mean flow of 24 cfs on 12 September 2012 was the lowest in the 38 years of record. On July 20, 2012, the flows of the Little Blue at Hollenberg gage fell below the compact target, and 111 junior irrigation rights and 129 storage rights in the Basin were closed. The 133 senior irrigators in the Basin were allowed to continue operating but were closely regulated. On 8 August 2012, the junior irrigation rights and the storage rights were closed again and they remained closed through September 30th which is the end of the compact period for target flows (Kansas-Nebraska Blue River Compact Annual Report 2013). In 2012, the Little Blue River was below the minimum mean daily flows for 69 days.

The graph below illustrates the increases in the frequency of administration for compact compliance. This pilot project would not significantly reduce the number of days of administration, but over time, the cumulative impacts of numerous small-scale recharge projects could increase the number of days per year.



8. Reduces threats to property damage or protects critical infrastructure that consists of the physical assets, systems, and networks vital to the state or the Untied States such that their incapacitation would have a debilitating effect on public security or public health and safety;

- Identify the property that the project is intended to reduce threats to.
- Describe and quantify reductions in threats to critical infrastructure provided by the project and how the infrastructure is vital to Nebraska or the United States.
- Identify the potential value of cost savings resulting from completion of the project.
- Describe the benefits for public security, public health and safety.

Property
The instream weir and remnant oxbow project will protect the property on which the structures are built from eroding and adjacent infrastructure such as buildings, roads, and bridges. This will also prevent land value degradation due loss of valuable farmland.

Reductions to Infrastructure Threats
Streambank and streambed degradation destabilizes streams and threatens surrounding property and infrastructure. This is a serious issue throughout Nebraska, particularly related to bridges. The cost for repairing and replacing bridges is very high and the environmental permitting requirements associated with large streambank stabilization projects is very challenging.

Cost Savings
The project provides a potential cost savings to government agencies by preventing channel degradation and downcutting from migrating upstream, which would undermine the integrity of the infrastructure.

Public Safety Benefits
The project provides a public safety benefit by preventing the degradation of streambanks and streambeds that can undermine the integrity of infrastructure.

9. Improves water quality;

- Describe what quality issue(s) is/are to be improved.
- Describe and quantify how the project improves water quality, what is the target area, what is the population or acreage receiving benefits, what is the usage of the water: residential, industrial, agriculture or recreational.
- Describe other possible solutions to remedy this issue.
- Describe the history of the water quality issue including previous attempts to remedy the problem and the results obtained.

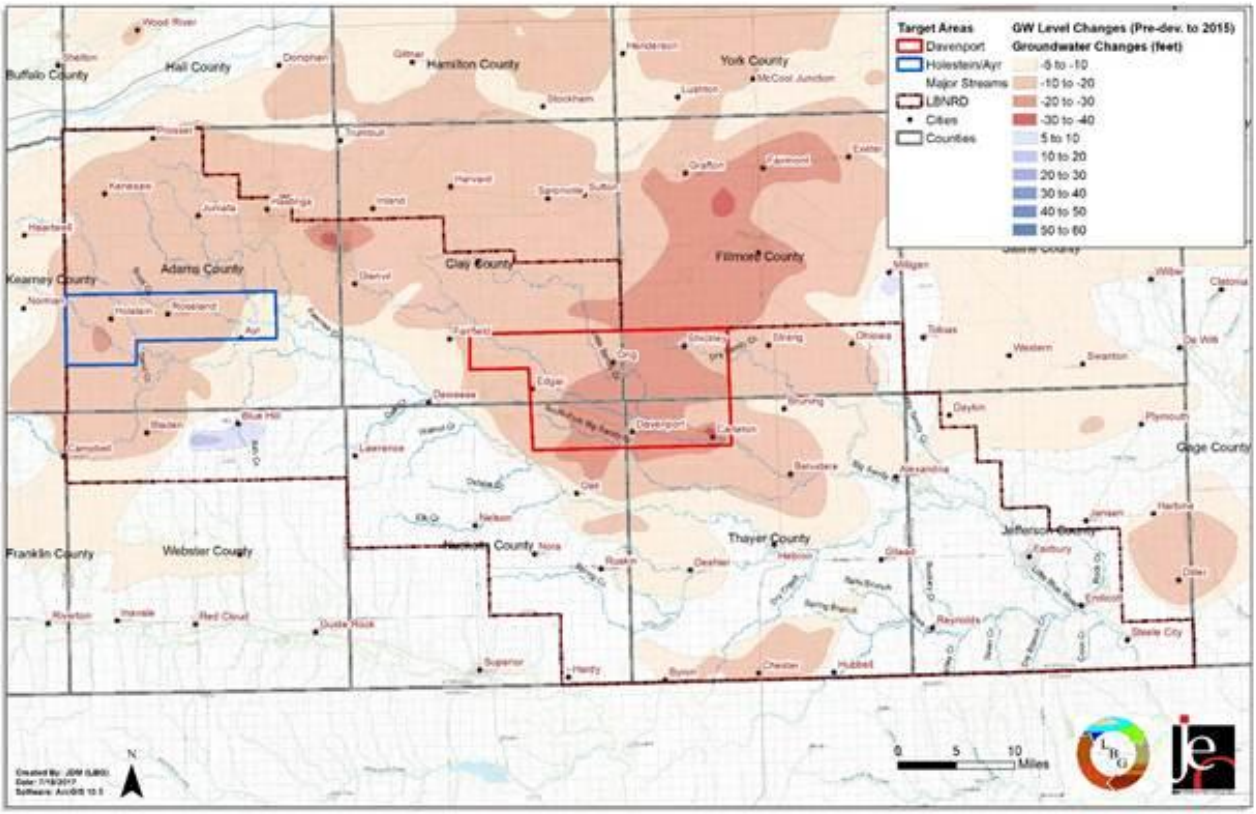
What quality issues are to be improved.
Each project will protect downstream waterways from the impact of nutrient pollution by trapping and filtering pollutants within oxbow areas during high flow events. Nutrients will be removed and used by newly established and enhanced wetland vegetation. Bacteria in the stream will be reduced through natural attenuation within pooled areas. Sediment will be trapped within oxbow areas.

Quantify how the project improves water quality, the target area, etc.
Through reconnection of the three oxbows (Site 8, Site 36, and Site 1B) a total of six surface acres and 1.5 miles of stream will be reconnected to the natural system. The weirs at Site 1C will create deep pools, which will enhance aquatic habitat, including wetland plants, and will naturally remove pollutants.

Specific AGR target areas were established by LBNRD within the Methodology document based upon:

- Location of active waterways (or formerly active) using the USGS National Hydrology Dataset (NHD)
- Groundwater declines since pre-development (UNL CSD)
- Input from LBNRD on areas with known groundwater quantity issues. Groundwater recharge target areas, shown with groundwater declines are illustrated in Figure below.

Increasing the storage capacity of local groundwater aquifers benefits all who utilize groundwater, including agricultural producers, municipalities and private well owners, and recreationist. As groundwater levels are restored to more sustainable levels, perennial flow in streams, that are now dry, are more likely to resume a more regular flow pattern, thus benefiting fish and wildlife, recreation users, and ensuring adequate flows into Kansas.



Solutions to remedy this issue.
Other possible solutions include non-structural practices, such as no-till, cover crops, Conservation Reserve Program, and similar practices that allow precipitation and runoff to infiltrate into the aquifer. Many of these practices are already in place and LBNRD will be finding ways to increase implementation of these types of practices within recharge target areas as part of future projects.

History of the water quality issues and previous attempts to remedy the problem
Improving water quality is one of the primary objectives of the NRD system. LBNRD completes water quality projects and encourages producer implementation of water quality practices on an ongoing basis. The LBNRD 2015 WMP establishes water quality goals and prioritized land into 'target areas' to maximize resources into areas of greatest need. The 2015 WMP resulted in the LBNRD hiring additional staff with a sole purpose of improving water quality within selected target areas.

10. Has utilized all available funding resources of the local jurisdiction to support the program, project, or activity;

- Identify the local jurisdiction that supports the project.
- List current property tax levy, valuations, or other sources of revenue for the sponsoring entity.
- List other funding sources for the project.

Local Jurisdiction Support
The LBNRD established a Projects Sinking Fund in 2012 devoted to the development of various unspecified flood control, erosion control, and groundwater recharge projects throughout the District. The Sinking Fund currently has over $475,000 in reserve for such project development and a portion of these funds will be designated for this stabilization/recharge project.

Current Property Tax Levy
The LBNRDs mill levy at the time of application is $0.017706 per $100 in valuation. The maximum NRD mill levy of $0.045 per $100 of valuation. The valuation of the LBNRD is $9,334,690,475 resulting in $1,652,802 in tax revenues for District projects, activities and operations in FY2017. Based on the 2017 District valuations, the District taxing authority could generate $4,200,610 in local tax revenues. Revenues generated from local taxes will be used for all necessary operation, maintenance and replacement costs of the structure in the future

Other Funding Sources
The LBNRD intends to submit a grant application to the Nebraska Environmental Trust (NET) for this project. The final amount of that grant request is not finalized, nor is approval of that request guaranteed. Therefore, the LBNRD is assuming no other funding sources will be obtained and is asking that the WSF and LBNRD cost-share this project at 60%/40%, respectively. Should the NET request be approved, the LBNRD will then work with the WSF to reduce their shares appropriately.

The LBNRD has the funds dedicated to meet the local match for this project.

11. Has a local jurisdiction with plans in place that support sustainable water use;

- List the local jurisdiction and identify specific plans being referenced that are in place to support sustainable water use.
- Provide the history of work completed to achieve the goals of these plans.
- List which goals and objectives this project will provide benefits for and how this project supports or contributes to those plans.
- Describe and quantify how the project supports sustainable water use, what is the target area, what is the population or acreage receiving benefits, what is the usage of the water: residential, industrial, agriculture or recreational.
- List all stakeholders involved in project.
- Identify who benefits from this project.

Local Jurisdiction & Water Plans

The LBNRD has authority and jurisdiction to manage groundwater resources through the Nebraska Groundwater Management and Protection Act (Neb. Rev. Stat. 46-702, 46-703,46-704), which states that natural resources districts have the legal authority and are the preferred regulators of groundwater quantity and quality management. Through their management authorities, the LBNRD adopted the Little Blue River Basin Water Management Plan in 2015 (2015 WMP), and the District is currently developing an Integrated Management Plan (VIMP) with NDNR that will further address hydrologically connected areas. This plan formalized goals to address groundwater declines and streamflow effects due to groundwater pumping. As this plan is recent, there is no history of plan implementation or monitoring the progress of plan goals and objectives.

Goals and Objectives

Little Blue River Water Management Plan (2015).

Goal #2: The LBNRD will achieve sustainability of water resources in the Little Blue River Basin with a better understanding of groundwater and surface water quantities, and facilitating the implementation of projects that use both resources to recharge groundwater aquifers and maintain flows.

Objective: The NRD will manage water resources in a manner that will further enhance capabilities for agricultural development while maintaining necessary stream flows in the Little Blue River.

Task 1: Reduce impacts to surface water irrigators by implementing programs, projects, and actions that will increase perennial stream flows during dry periods.

Task 2: Utilize the excessive Little Blue River (and its tributaries) surface water flows to recharge groundwater aquifers within the Basin to support sustainability of irrigation and the local economy.

Task 3: Facilitate the construction of in-stream structural groundwater recharge practices.

Task 4: Recharge groundwater by using excess flows by diverting water to adjacent wetlands, oxbows, and other features.

Voluntary Integrated Management Plan (currently under development).

Goal #2: Scientifically sound, locally-based management actions to protect interconnected groundwater and surface water.

Objective 3: Identify and use new opportunities to increase availability of water.

- Investigate and develop water storage, groundwater recharge and augmentation projects in areas where long-term groundwater level declines exist.
- Investigate and develop cost-effective projects which capture and store storm water runoff, increase groundwater recharge, and support stream base flow.
- Support efforts to prevent invasive species which consume water resources.

Sustainable Water Use & Benefits
There are 43 communities within the Little Blue Basin each listed below with their 2010 census population. By using information from both NRDs, the total population of the basin area, including rural areas, was estimated at just below 50,000. These municipalities rely upon groundwater for their potable water supplies. Similar structures, placed near these municipal well fields could have significant benefits during dry years, such as 2012. That severe drought, even with significant water restrictions, placed many communities in a concerned position regarding the wellfield ability to continue supplying water.

Project Stakeholders
Stakeholders involved include the citizens of the LBNRD and the current land owners. The Nebraska Department of Natural Resources is not a stakeholder, as project components would store less than 15 acre feet of water. The Nebraska Department of Environmental Quality is a potential stakeholder, if NPDES Construction Storm Water General Permits are necessary.

Project Beneficiaries
The most direct benefits are to the citizens of the District who rely on groundwater for drinking water and irrigation. Also, landowners who will experience less erosion of the grassland and streambed through installation of the instream stabilization structures. Other benefits include downstream users through decreased sediment turbidity. Over time, numerous small structures, placed strategically throughout the stream reach would significantly reduce sediment loads and increase water quality for downstream users.

12. Addresses a statewide problem or issue;

- List the issues or problems addressed by the project and why they should be considered statewide.
- Describe how the project will address each issue and/or problem.
- Describe the total number of people and/or total number of acres that would receive benefits.
- Identify the benefit, to the state, this project would provide.

Statewide Issues
Compact compliance-while the state currently complies with the Little Blue River Compact, it requires administration of junior surface water users. Projects that enhance streamflows during compact delivery periods reduce the impacts to surface water users.

Statewide Benefits
The project address groundwater declines by enhancing aquifer recharge of approximately 199 acre-feet per year, or 9,950 acre-feet over 50 years. Surface water depletions—the project addresses streamflow depletions by re-timing surface water flows. The re-timing relies upon using the aquifer as a temporary storage facility that slowly seeps water back to the stream over time. The nature of this project, as a small-scale pilot project, initially limits the benefits to a small number of individuals or acres. However, successful implementation of this project will lead to other small-scale recharge projects throughout the basin. The small vs large project approach has several long-term, cumulative advantages. First, small-scale projects are easy to permit and are more cost-effective than many sizeable reservoirs. Second, the small structural size makes it easier to install numerous structures in a larger geographic region. The larger geographic footprint allows for opportunities to address aquifer declines or streamflow depletions on a larger geographic scale than a single large project.

Benefit to the State
The State would benefit by addressing issues related to groundwater declines and streamflow depletions. The state would benefit by decreasing the adverse impacts to junior surface water users that face administration by augmenting streamflows. As a pilot project, the information gathered would be shared with the other NRDs across Nebraska through outreach. Ultimately without this project, a critical resource, water will continue to flow out of the LBNRD and the State of Nebraska and its beneficial use will be lost.

13. Contributes to the state's ability to leverage state dollars with local or federal government partners or other partners to maximize the use of its resources;

- List other funding sources or other partners, and the amount each will contribute, in a funding matrix.
- Describe how each source of funding is made available if the project is funded.
- Provide a copy or evidence of each commitment, for each separate source, of match dollars and funding partners.
- Describe how you will proceed if other funding sources do not come through.

Other Partners
These projects will be joint projects between the LBNRD, Nebraska Natural Resources Commission, and the landowners, for the benefit of the entire District. No other partnerships are anticipated.

Other Funding Sources
The LBNRD intends to submit a grant application to the Nebraska Environmental Trust (NET) for this project. The final amount of that grant request is not finalized, nor is approval of that request guaranteed. Therefore, the LBNRD is assuming no other funding sources will be obtained and is requesting that the Water Sustainability and

LBNRD cost-share the full project at 60%/40%, respectively. Should the NET request be approved, the LBNRD will then work with the WSF to reduce their shares appropriately.

The LBNRD has the funds dedicated to meet the local match for this project.

14. Contributes to watershed health and function;

- Describe how the project will contribute to watershed health and function in detail and list all of the watersheds affected.

All four sites are within the same Hydrologic Unit Code (HUC) 8 watershed, the Upper Little Blue (10270206) and therefore will all benefit the Little Blue River watershed. Locally, projects are located within the following HUC 12 watersheds:

- Site 8 – Sorge Oxbow, City of Carleton, (102702060804)
- Site 36 – Fredrick's Oxbow, Scott Creek, (102702060306)
- Site 1B – Allen Oxbow, Oak Creek-Little Blue River, (102702060410)
- Site 1C – Allen Weirs, Outlet Thirty-Two Mile Creek, (102702060404)

Reconnecting relic streamside oxbows provides numerous water quality benefits including:

- Reestablishing a contiguous riparian corridor and a more natural hydrologic regime.
- Restoration of former wetlands and improvement of the quality of existing wetland habitat.
- Wildlife and aquatic habitat enhancement
  Restored stability, function, and dynamic processes of the floodplain to a more natural, less degraded condition, which is present as a result of past stream straightening.

15. Uses objectives described in the annual report and plan of work for the state water planning and review process issued by the department.

- Identify the date of the Annual Report utilized.
- List any and all objectives of the Annual Report intended to be met by the project
- Explain how the project meets each objective.

This project is using the NDNR 2015 Annual Report and Plan of Work for the Nebraska State Water Planning and Review Process.

Specifically, this project meets three of five implementation focused objectives listed in the plan:

Objective 2. *Provide staff and resources to support planning and implementation of water resources projects.* LBNRD has allocated a specific position to work with the remainder of the staff within the NRD to implement the 2015 Little Blue River Water Management plan. This person is responsible for oversight of this project and other ongoing projects throughout the NRD.

Objective 3. Support locally developed water management plans for managing hydrologically connected water supplies. LBNRD is in the process of writing the Voluntary Integrated Management Plan (VIMP) and has established the 2015 WMP and is updating rules and regulations related to groundwater quality and quantity as part of their Groundwater Management Plan.

Objective 5. Provide coordination of federal agencies, state agencies, and local natural resources districts (NRDs), and other water interests for the development of water resources programs and projects. LBNRD is coordinating with the Nebraska Department of Natural Resources, Natural Resources Commission, Nebraska Environmental Trust, and private land owners on this specific effort. The VIMP is being established in collaboration with Tri-Basin NRD.

16. Federal Mandate Bonus. If you believe that your project is designed to meet the requirements of a federal mandate which furthers the goals of the WSF, then:

- Describe the federal mandate.
- Provide documentary evidence of the federal mandate.
- Describe how the project meets the requirements of the federal mandate.
- Describe the relationship between the federal mandate and how the project furthers the goals of water sustainability.

While there is no specific federal mandate, LBNRD's AGR efforts will work towards complying with the 1971, Kansas-Nebraska Big Blue River Compact (Compact). The Compact established minimum flow requirements for the Little Blue River. The flow requirements are 45 cubic feet per second (cfs) in May and June 75 cfs in July 80 cfs in August, and 60 cfs in September. There are no minimum flow requirements for October through April. The Hollenberg, Kansas stream gage is the measuring point. If stream flows fall below the Compact minimum flow requirements, the NDNR imposes administration actions on surface water irrigators holding water rights within the basin.

Several streams have experienced a decrease in flows throughout the Little Blue River basin. A University of Nebraska-Lincoln (UNL) study released in 2007, suggested that changing land uses, increased vegetation along stream corridors, and increased irrigation pumping could be contributing to the decreased flow. Additionally, a transition to highly-efficient pivot irrigations systems has decreased the quantity of return flows to streams from groundwater-supplied furrow irrigation systems over the last 20 years.

This AGR project, past AGR projects, and future AGR projects, are all intended to increase groundwater storage within the aquifer, which will increase perennial stream flow. Increasing perennial stream flow supports the State of Nebraska's efforts to comply with the 1971 Compact.

Appendices and References

Appendix A. Little Blue Natural Resources District, 2016 Feasibility Study Report: Instream Weir Stabilization/Recharge Pilot Project.

Appendix B. Little Blue Natural Resources District, 2017 Prioritization Methodology Report for Groundwater Recharge, Flood Protection, and/or Oxbow Reconnection Projects.

Appendix C. Little Blue Natural Resources District, 2017 Recharge Projects Evaluation Matrix.

Little Blue Natural Resources District, 2011 Final Study Hydro-Geologic Study, http://www.littlebluenrd.org/hydrogeologic_study.html

Little Blue Natural Resources District and Tri-Basin Natural Resources District, 2015 Little Blue River Basin Water Management Plan, http://www.littlebluenrd.org/Water/basin_water_plan.html

Little Blue Natural Resources District, 2017 Little Blue & Tri-Basin NRD Voluntary Integrated Management Plans, http://jeo.com/projects/little-blue-vimp

Section D.

PROJECT DESCRIPTION

1. Overview

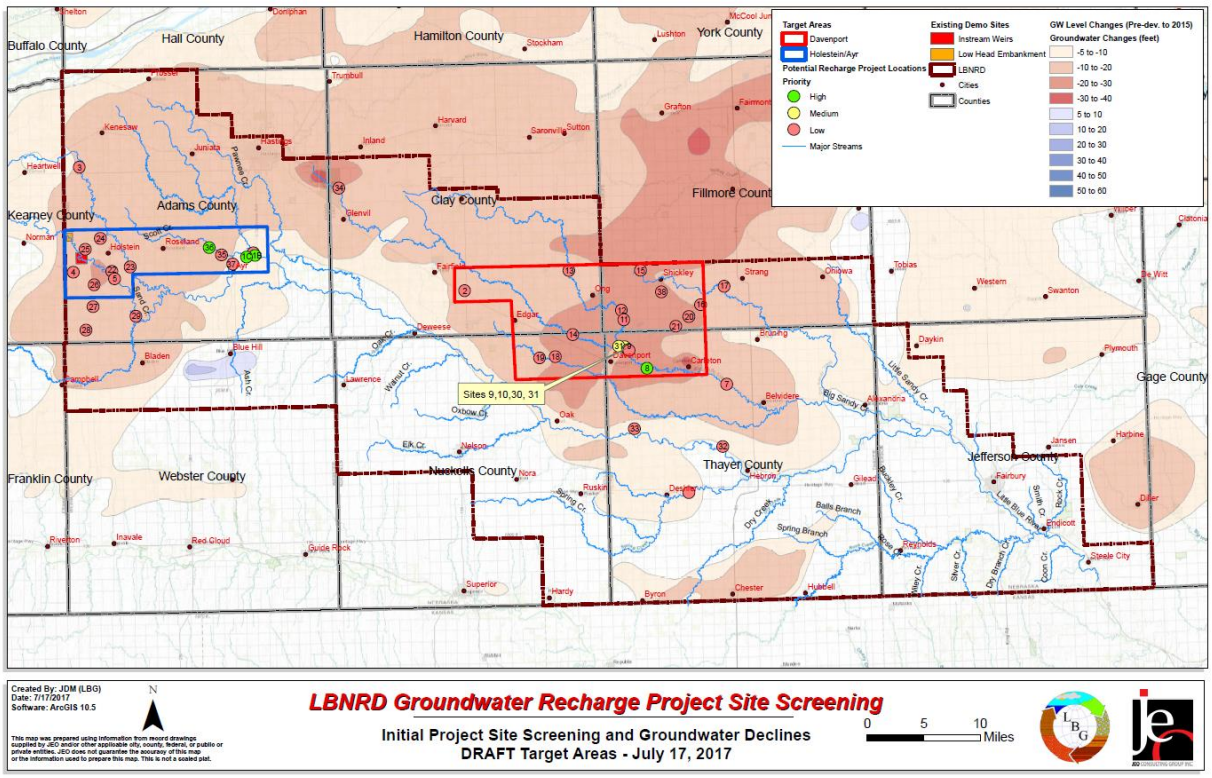
In 1,000 characters *or less*, provide a brief description of your project including the nature and purpose of the project and objectives of the project.

Project Description
The Little Blue Natural Resources District (LBNRD) is requesting Water Sustainability Funds (WSF) to cost-share the design, permitting, and construction of small instream weirs and remnant oxbows at four (4) sites within the Little Blue River basin and to install monitoring equipment at these sites to evaluate recharge performance.

The Little Blue NRD Oxbow Reconnections for Groundwater Recharge projects selected will provide multiple benefits that are consistent with the intent of the WSF Program. The small instream weirs and remnant oxbows will provide:

- groundwater recharge,
- flood control measures,
- streambank and streambed stabilization,
- water quality enhancements,
- wetland restoration, and
- creation of wildlife and waterfowl habitat.

Even though the project is at a conceptual design stage, the intent is that these recharge structures can be used as a template for other projects on a Statewide basis by demonstrating how improvements, such as small instream weirs and remnant oxbows, can provide many quantifiable benefits within a watershed or sub-watershed basin. A site map is provided below.



These recharge structures will be designed by professional engineers and geologists licensed in the State of Nebraska and other qualified environmental and water-resources professionals.

Nature of the Project

The Little Blue NRD Oxbow Reconnections for Groundwater Recharge is a phased project. As discussed previously, the first phase began in 2017 with the construction of small instream weirs and low-head embankment stabilization recharge structures to capture excess surface water flows. This second phase will focus on the design and construction of reactivating remnant oxbows by reconnecting them to the river and installing small instream weirs. The LBNRD has completed a conceptual design for this second phase of projects and is incorporated into this study. The conceptual design utilized LiDAR, field reconnaissance, and available hydrologic and physical data to engineer the project. Final design, permitting, and construction will be completed upon award of the WSF grant

Due to the extensive magnitude of the water resources issues, and ultimately the cost to remedy the problem, the LBNRD's mitigation efforts will be phased over multiple years. As described previously, the first phase focuses on instream weirs that partially impound streamflow and thereby enhanced groundwater recharge. This second phase, discussed in the following Project Description Section of this proposal, will build upon these past efforts by installing four (4) recharge structures

at selected site within the District and monitoring equipment to evaluate recharge performance. Engineering designs can be modified to improve performance and the most effective technologies will be deployed at these sites.

To assist in site selection, the LBNRD developed the Prioritization Methodology Report for Groundwater Recharge, Flood Protection, and/or Oxbow Reconnection Projects in June 2017 (Methodology), see Appendix B. The intent of the Methodology is to create a uniform process to screen and prioritize projects with the goal of groundwater recharge, flood reduction, streambank and streambed stabilization, water quality improvement, wetland restoration, and wildlife and waterfowl habitat creation. The Methodology created a uniform system to screen projects within targeted areas of the LBNRD that can be used each time new projects are considered. The site selection was a measured and detailed process. Multiple physical and hydrologic characteristics were examined for 38 sites to determine the best sites to achieve the project goals and for construction. The best projects are listed in the LBNRD Recharge Projects Evaluation Matrix shown below. For the complete Recharge Projects Evaluation Matrix for all 38 sites see Appendix C. Based on the Matrix, four (4) sites were selected for conceptual project design, including an initial permitting evaluation and wetland delineations

LB NRD Recharge Projects Evaluation Matrix			Technial Feasiblity	Construction Cost	Use of Existing Infrastructure	Site Access and Conditions	Aquatic Habitat Enhancement	Regulatory Implications	Groundwater Quality Impacts	Surface Water Quality Benefits	Water Source Availability	Proximity to Consumptive Uses	Flood Protection	Operation and Maintenance	Artificial Recharge Potential	Weighted Score
		Weighting Factor	*3*	*3*	*1*	*3*	*1*	*3*	*1*	*2*	*3*	*2*	*2*	*2*	*3*	125
Project #	**Project Name**	**Target Area**														
1B	Oxbow Reconnection (small) - NE of Ay	Ayr	3	5	4	5	4	4	1.5	4	4	4	2.5	3.5	4	96.5
36	Oxbow/weirs 3 NW of Ayr	Ayr	5	4	4	4	4	3	2	3	4	3	3	3	4	92.5
1C	In-stream Weirs - NE of Ayr	Ayr	3	4	4	5	4	4	1.5	4	4	4	1	3.5	3.5	90.25
8	Oxbow (big) 3 E of Davenport	Davenport	4	3	4	3	4	3	2	4	4	3	3	3	4	86
30	Oxbow 1 NE of Davenport	Davenport	4	4	4	1	3	3	2	3	3	3	3	3	3	75.5
2	Sandpit east of Fairfield	N/A	3.5	1.5	5	3.5	1	3	4	4	2.5	3.5	2.5	2.5	2.5	73
11	Oxbow 3 North of Davenport	Davenport	3	3	3	1	3	3	3	4	3.5	3	3	3	3	72.75
1A	Oxbow Reconnection (large) - NE of Ay	Ayr	2	2	3	2	4	2.5	1.5	4	2.5	4	3.5	3.5	3.5	70
9	Sandpit Wetlands	Davenport	3	3	3	1	2	3	2	3	3	3	3	3	3	68
10	Wetlands	Davenport	3	2	2	1	4	3	2	3	3	3	3	3	3	66.5
31	Oxbow 1 N of Davenport	Davenport	3	3	3	1	3	2	2	3	3	3	3	3	3	66.5
37	Oxbow large 1 N of Ayr	Ayr	3	3	3	1	3	2	2	3	3	3	3	3	3	66.5
35	Weirs Scott Creek 2NW of Ayr	Ayr	3	2	2	1	2	2	2	2	4	3	1	3	4	63

The four (4) sites for final design and construction include:

- Site 1B – Allen Small Oxbow
- Site 1C – Allen Instream Weirs
- Site 8 – Sorge Oxbow and Weir
- Site 36 – Frederick Oxbow

Project Purposes
The purposes of the project are to: recharge groundwater, provide flood reduction, stabilize streambanks and streambeds, improve water quality improvement, restore wetlands, and create wildlife and waterfowl habitat.

Project Objectives
- To conserve a critical resource, water, from flowing out of the LBNRD and the State of Nebraska and losing its beneficial use
- Construct small instream weirs and remnant oxbows at four (4) sites
- Recharge the groundwater with approximately 199 acre-feet of water per year
- Stabilize streambanks and streambeds and reduce loadings of sediment and other pollutants
- Restore wetlands and create wildlife and waterfowl habitat
- Monitor performance to determine the effectiveness of the structure and to use measured data to improve future engineering designs

2. Project Tasks and Timeline

Identify what activities will be conducted by the project. For multiyear projects please list what activities are to be completed each year.

Major project tasks and general timeline
- Establishment of screening methodology (April – June 2017)
- Selection of 38 potential project sites (June 2017)
- Screening of project sites down to nine, site visits (July 2017)
- Conceptual site design (July 2017)
- Establishment of a monitoring plan (July 2017)
- WSF funding application (July 2017)
- Wetland delineations (August 2017)
- Obtain WSF funding (December 2017)
- Obtain all permits (January to April 2018)
- Topographic survey (January 2018)
- Final design/hydraulic modeling (March 2018)
- Installation of monitoring equipment (April to December 2018)
- Construction (May to December 2018)
- Monitoring (Ongoing)
- Operation and Maintenance (Ongoing)

3. Partnerships

Identify the roles and responsibilities of agencies and groups involved in the proposed project regardless of whether each is an additional funding source. List any other sources of funding that have been approached for project support and that have officially turned you down. Attach the rejection letter.

The LBNRD will be the lead agency and responsible party for this project. These projects will be joint projects between the LBNRD, Nebraska Natural Resources Commission, and the landowners, for the benefit of the entire District. No other partnerships are anticipated.

4. Other Sources of Funding

Identify the costs of the entire project, what costs each other source of funding will be applied to, and whether each of these other sources of funding is confirmed. If not, please identify those entities and list the date when confirmation is expected. Explain how you will implement the project if these sources are not obtained.

List the Estimated Project Costs:

- Engineering and Construction: $538,000
- Annual Operation and Maintenance Costs: $ 4,400
- Land Acquisition Costs: $ 7,000
- Monitoring, Assessment, and Outreach: $104,700

The LBNRD intends to submit a grant application to the Nebraska Environmental Trust (NET) for this project. The final amount of that grant request is not finalized, nor is approval of that request guaranteed. Therefore, the LBNRD is assuming no other funding sources will be obtained and is asking that the Water Sustainability and LBNRD share the full costs of this project at 60%/40%, respectively. Should the NET request be approved, the LBNRD would then work with the WSF to reduce their shares appropriately.

5. Support/Opposition

Discuss both support and opposition to the project, including the group or interest each represents.

Support

The LBNRD has contacted multiple landowners to inquire about interest in participating in this project. There are interested landowners, particularly ones who know the importance and value of groundwater for the area and recognize the opportunity for groundwater recharge. The projects will be located exclusively on the lands of those willing landowners and no adverse impacts to neighboring lands are anticipated.

Opposition

There is no known opposition to the project.