LOWER LOUP
NATURAL RESOURCES DISTRICT

2018

LOWER PLATTE BASIN COALTION ANNUAL REPORT

DATE:

February 28, 2018

Table of Contents

CERTIFIED IRRIGATED ACRES 2
MUNICIPAL AND INDUSTRIAL GROUNDWATER USE 3
NEW GROUNDWATER CONSUMPTIVE USE – WELL CONSTRUCTION PERMITS GRANTED 7
APPROVED WATER TRANSFERS 7
WATER BANKING 8
EXPEDITED VARIANCES 9
NRD MANAGEMENT: WELL AGREEMENTS 9
NRD MANAGEMENT: ACRE ROTATIONS 10
FLOWMETER DATA 11
GROUNDWATER ACRES ALLOCATIONS 12
NEW GROUNDWATER ACRES ALLOCATIONS DEPLETION IMPACT 13
DEPLETION ACCOUNTING 15
GROUNDWATER ELEVATION DATA 16
NEW DATA COLLECTED OR MODEL/STUDY RESULTS 16
NON-ACTION/REPORTING ITEMS 17

2018 ANNUAL DOCUMENTATION OF IN THE LOWER LOUP NRD

REQUIREMENT OF LOWER PLATTE BASIN COALITION (LPBC)

BASINWIDE WATER MANAGEMENT PLAN

CERTIFIED IRRIGATED ACRES

The Lower Loup Natural Resources District (LLNRD or District) began the process of irrigated acres certification in 2006 and it was completed January 1, 2008. The District required that both ground water and surface water irrigated acres be certified through its process. The acres to be certified must be capable of being supplied with ground or surface water through irrigation works, mechanisms or facilities at the time. The certification must include a completed District certification form, an assessor document with a raised seal, and FSA aerial photo with irrigated fields delineated. A District GIS shapefile of the field boundary was created using ArcGIS to allow accounting and compliance reviews.

Following January 1, 2008, to certify a property as being irrigated, a landowner must show proof of irrigation at least 2 out of the 10 years for the period from 1998 – 2008. Documentation considered for the process of certification includes but is not limited to: FSA compliant photos and 578 forms depicting certified irrigated boundaries, county assessed records, and conservation easement agreements with programs such as CRP. Certification is constantly tracked through the GIS table and field boundary adjustments take place annually. Additionally, the entire District is flown for active chlorophyll measurements recorded through infrared photography and field boundaries and irrigation totals are measured and policed to prevent deviation from the original certification by NRD staff.

Detailed data regarding amount and water source of certified irrigated acres in the period between July 1, 2016 and December 31, 2017 can be found in **TABLE 1. Certified Acres** below. The difference in total certified acres (2016-2017) reflects newly irrigated acres as well as newly certified and re-certified acres where new evidence of irrigated crop history has been established according to LLNRD Rules and Regulations.

Table 1. Certified Acres 2016-2017

Year	Total Acres Certified	Acres of Ground Water	Acres of Surface Water	Acres of Co-Mingled
2016	1,221,208.154	1,017,818.17	155,180.613	48,209.371
2017	1,222,485.124	1,019,095.57	155,180.613	48,209.371
Difference 2016-2017	1,277.4 New acres 1,328.4 Result of Transfers 51.43	1,277.4 New acres 1,328.4 Result of Transfers -51.43		

MUNICIPAL AND INDUSTRIAL GROUNDWATER USE

The LLNRD is in the second year of collecting municipal water use data. At the end of 2016, letters were sent to either the Mayor or the Council Chair in all 43 communities explaining the District's goals and objectives that were found in our Integrated Management Plan. Developing and maintaining a comprehensive inventory of the location and source of the District's current and future water supplies, water uses, and outflows was Objective 1.1. To collect this data, a Municipal Accounting Form was developed and sent to the water operators of each community. An example form is attached as an appendix to this report.

For 2016, data was received from all but one of the 43 communities. In following up with the one community, it was discovered that they had problems with their accounting system and did not have accurate numbers to submit. The data was compiled, and total gallons pumped per person per day figure was documented for each community within the District.

A similar effort is underway for the 2017 year, as municipal records were requested back by January 31, 2018. As of the end of February, data was collected from 34 of the 43 communities. Effort to contact each of the remaining communities is taking place. Early comparisons between 2016 and 2017 indicate similar total gallons used, per person, per day with 259 gallons for 2016 and 256 gallons for 2017.

New to 2018, the LLNRD is working on updating our Groundwater Management Area Rules and Regulations to include industrial and municipal use and accounting. Collecting this data has been voluntary up to this point. These new rules will also define industrial and commercial uses in addition to municipal uses. Currently, the LLNRD is not fully appropriated, so rules will not necessarily follow current statutes found in LB 962.

***TABLE 2:* MUNICIPAL WATER USE IN THE LLNRD IN 2016.**

City Name	2016 Water Pumped	Population	Gal/per capita/per day	Connections	Metered
Albion, City of	110,599,010	1,650	183.6	938	Yes
Anselmo, Village of	19,495,900	145	368.4	101	Yes
Ansley, Village of	42,087,000	441	261.5	252	Yes
Arcadia, Village of	83,865,200	311	738.8	200	No
Arnold, Village of	73,000,000	597	335.0	395	Yes
Ashton, Village of	11,766,000	196	164.5	140	Yes
Bartlett, Village of	22,837,000	122	512.8	70	No
Belgrade, Village of	18,406,900	150	336.2	77	No
Boelus, Village of	10,212,000	193	145.0	115	Yes
Broken Bow, City of					
Burwell, City of	66,530,000	1,210	150.6	701	Yes
Cairo, Village of	66,123,000	800	226.4	335	Yes

***TABLE 2:* MUNICIPAL WATER USE IN THE LLNRD IN 2016.**

City Name	2016 Water Pumped	Population	Gal/per capita/per day	Connections	Metered
Callaway, Village of	26,086,470	537	133.1	350	No
Cedar Rapids, Village of	28,918,000	382	207.4	265	Yes
Columbus, City of	2,055,079,592	22,630	248.8	9,129	Yes
Comstock, Village of	5,848,200	110	145.7	67	Yes
Dannebrog, Village of	10,138,000	324	85.7	145	Yes
Duncan, Village of	22,722,000	359	173.4	170	Yes
Elba, Village of	17,638,000	215	224.8	128	Yes
Ericson, Village of	21,956,700	87	691.4	31	No
Farwell, Village of	9,693,800	124	214.2	80	Yes
Fullerton, City of	89,501,000	1,371	178.9	640	Yes
Genoa, City of	56,939,000	981	159.0	486	Yes
Greeley, Village of	37,098,000	431	235.8	335	Yes
Litchfield, Village of	18,514,400	262	193.6	147	Yes
Loup City, City of	355,226,000	1,029	945.8	585	Yes
Mason City, Village of	1,147,430	171	18.4	115	Yes
Merna, Village of	23,370,000	363	176.4	203	Yes
Monroe, Village of	17,095,400	284	164.9	146	Yes
*North Loup, Village of		297		153	Yes
Ord, City of	382,344,000	2,112	496.0	1,181	Yes
Palmer, Village of	18,247,000	472	105.9	230	Yes
Petersburg, Village of	25,000,000	333	205.7	200	Yes
Pleasanton, Village of	27,787,630	341	223.3	185	Yes
Primrose, Village of	15,984,000	65	673.7	35	Yes
Ravenna, City of	135,965,000	1,360	273.9	625	Yes
Rockville, Village of	4,110,700	110	102.4	48	Yes
Sargent, City of	52,768,530	550	262.9	338	Yes
Scotia, Village of	26,731,700	319	229.6	157	Yes

TABLE 2: MUNICIPAL WATER USE IN THE LLNRD IN 2016.

City Name	2016 Water Pumped	Population	Gal/per capita/per day	Connections	Metered
Spalding, Village of	19,541,188	487	109.9	359	Yes
St. Edward, Village of	67,473,500	705	262.2	340	No
St. Paul, City of	147,651,000	2,300	175.9	1,005	Yes
Wolbach, Village of	34,628,500	287	330.6	140	No
Total	**4,280,126,750**	**45,213**	**259**	**21,342**	

average gallons pumped per capita per day

*Water provided through City of Ord

-Population numbers were supplied by the municipality.

TABLE 3: MUNICIPAL WATER USE IN THE LLNRD IN 2017.

City Name	2017 Water Pumped	Population	Gal/per capita/per day	Connections	Metered
Albion, City of	119,624,000	1,650	198.6	842	Yes
Anselmo, Village of	22,760,800	159	392.2	94	Yes
Ansley, Village of	38,966,000	441	242.1	255	Yes
Arcadia, Village of	42,272,000	311	372.4	200	No
Arnold, Village of	105,000,000	597	481.9	395	Yes
Ashton, Village of	12,381,000	196	173.1	148	Yes
Bartlett, Village of					
Belgrade, Village of	18,537,700	150	338.6	77	No
Boelus, Village of	9,991,000	189	144.8	108	Yes
Broken Bow, City of	520,309,474	3,600	396.0	1,881	Yes
Burwell, City of	63,910,100	1,210	144.7	606	Yes
Cairo, Village of	58,872,000	800	201.6	335	Yes
Callaway, Village of					
Cedar Rapids, Village of					
Columbus, City of	2,044,335,701	22,630	247.5	9,154	
Comstock, Village of					

***TABLE 3:* MUNICIPAL WATER USE IN THE LLNRD IN 2017.**

City Name	2017 Water Pumped	Population	Gal/per capita/per day	Connections	Metered
Dannebrog, Village of					
Duncan, Village of	22,445,000	350	175.7	170	Yes
Elba, Village of	15,959,083	215	203.4	127	Yes
Ericson, Village of					
Farwell, Village of	12,486,000	128	267.3	70	No
Fullerton, City of	81,783,700	1,307	171.4	635	Yes
Genoa, City of					
Greeley, Village of	43,157,000	431	274.3	235	Yes
Litchfield, Village of	18,598,200	262	194.5	150	Yes
Loup City, City of	63,552,000	1,029	169.2	593	Yes
Mason City, Village of	1,354,380	178	20.8	115	Yes
Merna, Village of	24,444,000	353	189.7	204	
Monroe, Village of	15,601,000	284	150.5	146	Yes
*North Loup, Village of		297	0.0	153	
Ord, City of	404,142,000	2,409	459.6	1,400	
Palmer, Village of	26,006,000	472	151.0	230	Yes
Petersburg, Village of	24,225,000	325	204.2	220	Yes
Pleasanton, Village of	25,266,000	341	203.0	185	Yes
Primrose, Village of					
Ravenna, City of	122,007,000	1,360	245.8	625	Yes
Rockville, Village of	4,879,200	110	121.5	48	Yes
Sargent, City of	48,610,000	550	242.1	330	Yes
Scotia, Village of	24,425,800	319	209.8	150	Yes
Spalding, Village of	28,918,000	497	159.4	347	Yes
St. Edward, Village of	70,304,994	705	273.2	340	No
St. Paul, City of	148,687,000	2,300	177.1	1,100	Yes
Wolbach, Village of	59,126,000	287	564.4	188	No
Total	**4,342,937,132**	**46,442**	**256**	**21,856**	

*Water provided through City of Ord

-Population numbers were supplied by the municipality.

NEW GROUNDWATER CONSUMPTIVE USE – WELL CONSTRUCTION PERMITS GRANTED

The LLNRD established a well moratorium in 2007, before this date, all high-capacity wells (greater than 50 gallons per minute) were required to be permitted via a certified well permit issued by the LLNRD as dictated by the Groundwater Management Plan. New well permits are still required for all high-capacity wells and may still be issued for supplemental and replacement wells that are for non-irrigation uses. Any new high-capacity irrigation well must be previously approved through the variance process (see "Variance" portion of this report). LLNRD has approved 22 well permits from July 1 - December 31, 2016 and 59 well permits in 2017 for varied uses as reported in the table below. It should be noted that not all permitted wells should be automatically considered consumptive, especially in the case of supplemental, replacement and variance well permits.

***TABLE 4:* APPROVED GROUNDWATER WELL PERMITS IN THE LLNRD IN JULY 1 – DECEMBER 31, 2016.**

Groundwater Well Permit Types	Number of Permits	Average Pump Capacity (gpm)
Dewatering	8	950.00
Industrial	0	0.00
Irrigation (Total)	**11**	**863.63**
(Irrigation) Transfer	1	800.00
(Irrigation) Supplemental	1	850.00
(Irrigation) Variance	1	750.00
(Irrigation) New Acre	1	800.00
(Irrigation) Replacement	7	900.00
Livestock	2	100.00
Public Water Supply	1	700.00
Water Source Heat Pump	0	0.00
TOTAL	**22**	**745.96**

***TABLE 5:* APPROVED GROUNDWATER WELL PERMITS IN THE LLNRD IN 2017.**

Groundwater Well Permit Types	Number of Permits	Average Pump Capacity (gpm)
Dewatering	0	
Industrial	0	
Irrigation (Total)	**54**	**830.00**
(Irrigation) Transfer	10	745.00
(Irrigation) Supplemental	5	940.00
(Irrigation) Variance	0	
(Irrigation) New Acre	9	850.00
(Irrigation) Replacement	25	828.00
(Irrigation) Turf	1	500.00
Livestock	5	100.00
Public Water Supply	0	
Water Source Heat Pump	0	
TOTAL	**59**	**684.71**

APPROVED WATER TRANSFERS

The LLNRD Rules and Regulations allows any person to transfer groundwater irrigation rights from one location to another if the acres are certified by the District. Transfers can only occur downstream or to the adjacent section and cannot have a net increase impact on any stream based on the most recent stream depletion factor from the best groundwater model available. Acre transfers are only allowed to occur once per year. The deadline for application for transfer is March 1 of each year. In 2016 and 2017, the LLNRD approved 34 ***Agreements to Transfer Certified Irrigated Acres & Right to Use Groundwater*** agreements. There were no denials to any transfer requests. See the summary in Table 8 below. Transfer agreements are classified both by

landowners who are moving their irrigated acre rights (off) and those that are receiving the rights in another location (in).

***TABLE 6:* APPROVED CERTIFIED IRRIGATED ACRES TRANSFERS IN THE LLNRD IN 2016.**

County	# of Agreements Receiving Land owners	# of Agreements Transferring Land owners	Acres Transferred in	# New wells resulting from Transfer	Acres Transferred off	Avg Transferred In SDF	Avg Transferred Off SDF
Boone	6	3	108.9	0	52.90	.37	.31
Buffalo	3	2	127.00	2	117.90	.46	.74
Custer	4	6	147.40	2	285.46	.51	.68
Garfield	1	3	123.00	1	160.30	.89	.52
Greeley	7	0	195.49	1	0.0	.18	N/A
Howard	1	1	30.00	0	30.30	.90	.89
Platte	5	2	88.60	1	33.60	.24	.28
Rock	0	7	0.0	0	185.10	N/A	.44
Sherman	3	2	138.2	1	25.10	.46	.54
Valley	4	2	34.61	0	18.30	.53	.60
Wheeler	0	6	0.0	0	111.65	N/A	.43
Total	**34**	**34**	**993.20**	**8**	**1,020.61**	**.39**	**.51**

***TABLE 7:* APPROVED CERTIFIED IRRIGATED ACRES TRANSFERS IN THE LLNRD IN 2017.**

County	# of Agreements Receiving Land owners	# of Agreements Transferring Land owners	Acres Transferred in	# New wells resulting from Transfer	Acres Transferred off	Avg Transferred In SDF	Avg Transferred Off SDF
Boone	16	4	763.14	5	236.52	.55	.53
Buffalo	3	2	58.30	2	38.80	.79	.83
Custer	4	4	22.00	1	27.60	.24	.18
Garfield	2	3	84.00	0	98.80	.34	.40
Greeley	1	2	122.80	1	157.80	.26	.28
Howard	1	0	35.00	0	0	.67	Na
Nance	2	1	15.03	0	5.63	.82	.82
Sherman	1	2	20.20	0	40.20	.46	.64
Wheeler	4	16	122.00	1	688.55	.43	.59
Total	**34**	**34**	**1,242.47**		**1,293.90**	**.49**	**.52**

WATER BANKING

The LLNRD requires that all transfers result in no new net increase in depletions to any stream utilizing the most current stream depletion number extracted from each section. The section number is averaged from the best available groundwater/surface water model for use by LLNRD. The 2016 and 2017 section-assigned stream depletion factor (SDF) was utilized using the USGS Elkhorn-Loup Model (ELM) in its Phase 3 capacity. Any transferring of irrigated acre rights from a low to a higher SDF requires an offset. Acres transferred from a higher SDF to a lower SDF are only allowed at a 1:1 ratio, with the LLNRD banking the remaining difference. As a result of the 2016 transfers, the LLNRD has banked a total of **638.06** groundwater-irrigated acres. Because of the 2017

transfers, the LLNRD has banked a total of **223.92** groundwater-irrigated acres. Additional information regarding the ELM project can be found here:

https://pubs.er.usgs.gov/publication/sir20105149

EXPEDITED VARIANCES

The LLNRD Board of Directors has designated a set of conditions under which specific requests for a variance may be approved by methods other than the Variance Committee process. An expedited variance is a variance that meets LLNRD Board pre-approved conditions and as such does not need to be reviewed by the NRD Variance Committee. These expedited variances all have a Supplemental Well Agreement. There were no denials to any expedited variance requests. From July 1 - July 31, 2016, there were a total of 3 expedited variances and 7 expedited variances in 2017 (Table 9) that were approved through NRD processes.

***TABLE 8:* APPROVED EXPEDITED VARIANCES IN 2016 IN THE LLNRD.**

County	# of Supplemental Well Agreements	Permit Approved	Agreement Approved, but waiting on a Permit
Buffalo	2	0	2
Sherman	1	1	
Total	**3**	**1**	**0**

***TABLE 9:* APPROVED EXPEDITED VARIANCES IN 2017 IN THE LLNRD.**

County	# of Supplemental Well Agreements	Permit Approved	Agreement Approved, but waiting on a Permit
Boone	1	0	1
Buffalo	2	1	1
Custer	1	1	0
Garfield	1	1	0
Howard	1	1	0
Platte	1	1	0
Total	**7**	**5**	**2**

NRD MANAGEMENT: WELL AGREEMENTS

From July 1 - July 31, 2016, there were a total of 2 well agreements and 1 well agreement that was approved. These 3 well agreements were granted based on the stipulation that the landowner relinquish the existing surface water right held through the Department or Natural Resources processes. There were no denials to any variances with a well agreement request.

***TABLE 10:* APPROVED WELL AGREEMENTS IN THE LLNRD IN 2016.**

County	# of Supplemental Well Agreements	SW Agreed upon to be Relinquished	Permit Approved	SW Right Relinquishment Date
Howard	1	A-5198A A-6280A A-10246A	1	required to relinquish as of 6/2/17, well G-180213 registered 8/2/16
Sherman	1	A-10515	1	12/20/2016
Total	**2**	**4**	**2**	

***TABLE 11:* APPROVED WELL AGREEMENTS IN THE LLNRD IN 2017.**

County	# of Well Agreements	SW Agreed upon to be Relinquished	Permit Approved	SW Right Relinquishment Date
Valley	1	A-11216	0	Required to relinquish as of 4/19/17, but as of 1/18/18 still hasn't relinquished
Total	**1**	**1**	**0**	

NRD MANAGEMENT: ACRE ROTATIONS

Acre rotations are agreements set-forth by a participating landowner and the LLNRD, which allows a landowner options to choose how they distribute certified acres over a tract of land. From July 1, - July 31, 2016, there were two separate acre rotations and two different acre rotations in 2017 that were approved by the LLNRD. These 4 Acre Rotation Agreements have 2 or 3 options the land owner can choose in one calendar year. After an option is selected, the landowner notifies the LLNRD in writing prior to May 1st of that calendar year, before any irrigation is authorized. There were no denials to any acre rotation requests. Enforcement is conducted by the LLNRD through annual infrared imagery and field personnel visitation.

***TABLE 12:* APPROVED ACRE ROTATIONS IN THE LLNRD IN 2016.**

County	# of Acre Rotation Agreements Approved
Custer	2
Total	**3**

***TABLE 13:* APPROVED ACRE ROTATIONS IN THE LLNRD IN 2017.**

County	# of Acre Rotation Agreements Approved
Buffalo/Nance	1
Sherman	1
Total	**2**

FLOWMETER DATA

The LLNRD has collected ground and surface water use information for irrigation on an annual basis since 2010. Flowmeters have been cost-shared across the District on a voluntary basis since 2009. However, the LLNRD required that all high-capacity irrigation wells in Groundwater Management Area 28 (see Figure 5, inset) be outfitted with a flowmeter to track irrigation total withdrawals starting in 2016. In 2016, LLNRD has collected records of usage from 896 irrigation sites with 788 of those sites being verified as having an actual irrigation total water volume. The District average pumping withdrawals for irrigation for the 2016 season was 9.66 inches, with most of the crop being irrigated constituting entirely of either corn or soybeans.

The LLNRD continued monitoring irrigation totals for the 2017 season. There were 911 verified readings on irrigation flowmeters with an average irrigation total of 9.3 inches, down .36 inches from 2016. The required groundwater quality management area "Area 28" had the highest density of readings at 421 irrigation sites. Corn had the highest crop distribution across the District and was second highest in inches applied per acre at 10.43, behind potatoes at 11.31 inch/acre. An associated map of all 2017 readings is included at the end of this report (Map 1).

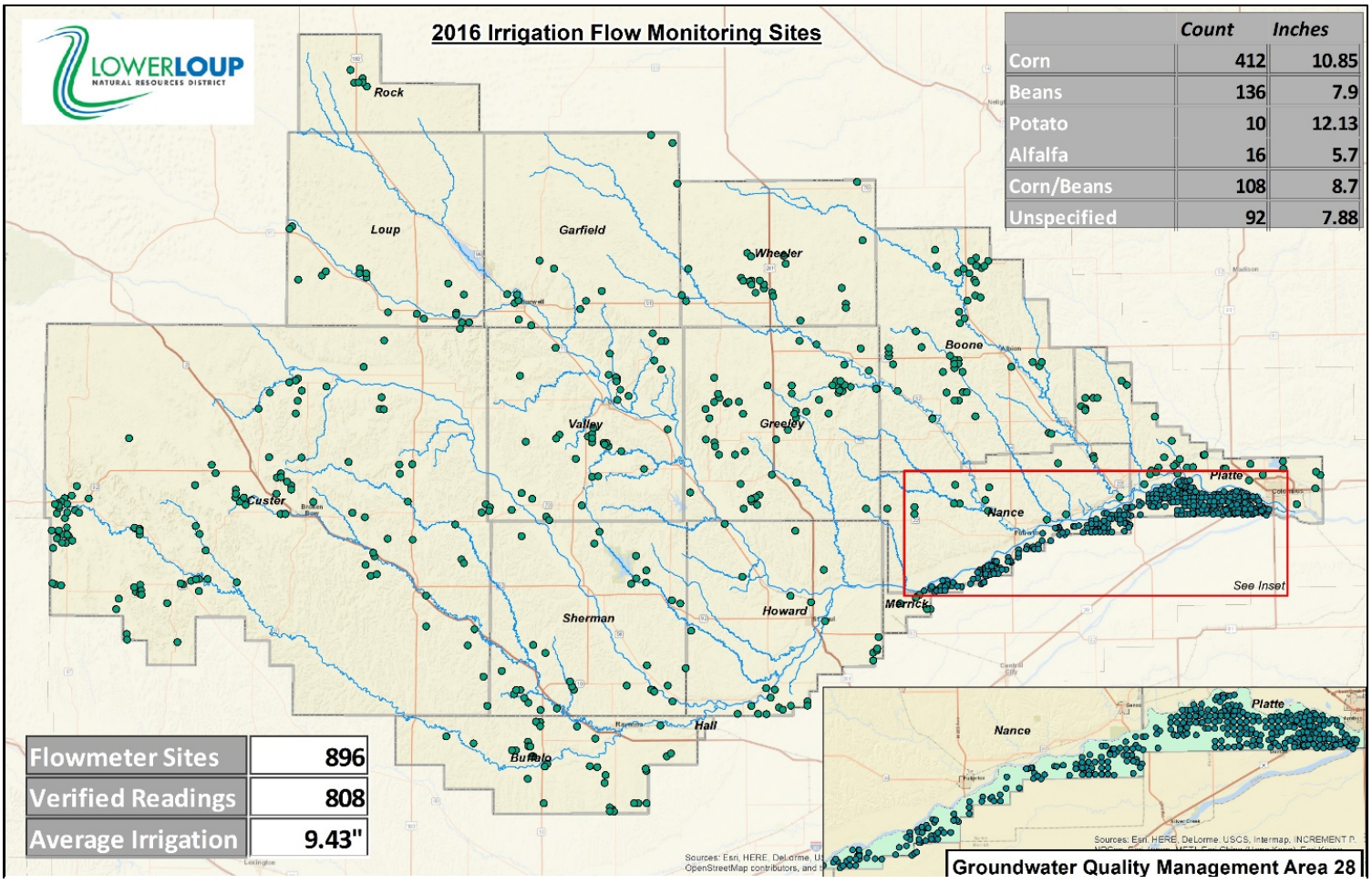


FIGURE 1: IRRIGATION MEASURING AND REPORTING SITES IN THE LLNRD IN 2016.

GROUNDWATER ACRES ALLOCATIONS

The LLNRD has the option to issue additional groundwater acre allocations each year based on the conditions of water resources in the District. New acres applications are accepted from September 1-20 when the Board authorizes additional development. In 2016, new acre applications were accepted in the North Loup River and Beaver Creek Sub-Basins and reviewed using District processes. There were 65 applications for new irrigation: 35 in the North Loup River Basin and 30 in the Beaver Creek Basin. The total number of acres requested in both basins was 4,943.05. The average application size requested 74 acres and the average application ranking was 255 points, ranked by LLNRD processes.

After the review process, there was a total of 1,996.28 new irrigated acres approved by the LLNRD Board of Directors. The Beaver and the North Loup basins were determined by the LLNRD to have available excess flows according to information contained within the NeDNR INSIGHT database and measured groundwater levels. Two other basins (Lower Loup and South Loup) showed a negative balance in the INSIGHT database. The LLNRD also considered areas of downward (negative) groundwater trends and did not approve acre applications in those water quantity areas. Both the INSIGHT databases and closed Water Quantity areas are indicated in the map on page 15.

At their meeting on October 27, 2016, the LLNRD Board of Directors unanimously approved all applications that ranked 230 points or greater. This meant approval of 20 new irrigated acre applications in the North Loup River Basin and 11 applications in the Beaver Creek Basin. There were 1,227.3 new acres approved in the North Loup and 768.9 in Beaver Creek.

Applications for new irrigation were ranked using District approved criteria. The criteria include Stream Depletion Factor, the status of nearby groundwater and surface water resources, the size of applications being applied for, and the soil classification.

TABLE 14: NEW GROUNDWATER-IRRIGATED ACRES APPROVED IN THE LLNRD IN 2016.

Basin	Number of Acres Approved	Pending Wells	Average SDF
Beaver	768.89	7	61%
North Loup	1,227.30	11	42%
Total	**1,996.19**	**18**	**51.5%**

In 2017, new acres applications were again accepted in the North Loup River and Beaver Creek Sub-Basins for a total of 1,464.04 new irrigated acres and have been approved by the LLNRD Board of Directors. These two basins continued to show upward or stable trends in both surface and groundwater resources (static water levels and stream gages). The Middle Loup River Basin, while showing upward trends in the stream gages, has had downward static water levels measured in the vicinity, especially south of the river.

There were 28 applications for new irrigation: 16 in the North Loup River Basin and 12 in the Beaver Creek Basin. The total number of acres requested in both basins was 1,507.00. The average application size requested 53.82 acres and the average application ranking was 267 points, ranked by LLNRD processes.

At their meeting on September 28, 2017, the LLNRD Board of Directors unanimously approved all applications that ranked 225 points or greater. This meant approval of 15 new irrigated acres applications in the North Loup River Basin and 10 applications in the Beaver Creek Basin. There were 677.14 new acres approved in the North Loup and 786.9 in Beaver Creek.

TABLE 15: **NEW GROUNDWATER-IRRIGATED ACRES APPROVED IN THE LLNRD IN 2017.**

Basin	Number of Acres Approved	Pending Wells	Average SDF
Beaver	786.9	6	60%
North Loup	677.14	6	48%
Total	1,464.04	**12**	**54%**

NEW GROUNDWATER ACRES ALLOCATIONS DEPLETION IMPACT

As part of the agreement to the Coalition planning effort, the associated Districts developed new depletion limits for the basin to evaluate basin water supplies moving forward. The Lower Platte Basin Coalition approved a methodology for determining the impact of individual allocations as well as accounting for the total amount of acre-feet (AF) impact moving forward. For agricultural uses, allowable number of irrigated acres in the hydrologically connected area can be determined by multiplying the number of acres, times the net irrigation requirement in feet, times the SDF as a decimal, times 30% depletions occurring during peak season. The Lower Loup NRD, being primarily encompassed by the Loup Basin, has agreed to 5,883 AF of allowable development over a five-year period.

After applying the agreed-upon methodology to the 2016 allowed irrigated acres, the AF impact was 204.52 AF of agriculture depletions. Table 13 has a breakdown of the numbers associated with the 31 applications.

TABLE 16: **NEW GROUNDWATER-IRRIGATED ACRES DEPLETIONS CALCULATED FROM THE 2016 ALLOCATION**

Application	LEGAL	Basin	ACRES	ELM_ SDF	NIR (feet)	Depletion Acre-feet
KETHE1	NW1/4 1-21N-7W BOONE	BEAVER	150.00	59.07	0.61	16.19
TIETR1	FR SW1/4 27-21-7W BOONE	BEAVER	14.00	74.02	0.64	1.99
JOCDA1	SW1/4 4-22N-7W BOONE	BEAVER	62.00	36.25	0.62	4.17
JSMM2	SE1/4 6-21-6W Boone	BEAVER	135.00	48.68	0.60	11.91
CARBE1	W1/2SE1/4 11-17-5W Nance	BEAVER	70.00	63.81	0.64	8.64
VANTR1	NE1/4 25-20-6W Boone	BEAVER	52.00	84.92	0.59	7.85
SWAJA1	SE1/4 9-17-4W Nance	BEAVER	32.60	89.33	0.65	5.67
MEJTH1	SW1/4 6-19-4W Platte	BEAVER	23.29	31.05	0.64	1.39
MICTR1	W1/2NE1/4 25-20-7W Boone	BEAVER	10.00	56.79	0.59	1.01
SWADE1	NW 3-17-4W Nance	BEAVER	86.00	95.03	0.65	15.88
DOZRA2	SW 10-22-7W Boone	BEAVER	134.00	36.94	0.62	9.19
HAMRO1	SW1/4 24-17N-14W VALLEY	NORTH LOUP	134.00	10.77	0.73	3.15
RICMI1	NE1/4 24-18N-15W VALLEY	NORTH LOUP	12.80	17.73	0.78	0.53
HANTR1	FR. SWSE 23-18N-12W GREELEY	NORTH LOUP	22.00	37.11	0.72	1.77
WHIAL1	SW1/4 20-17N-13W VALLEY	NORTH LOUP	80.00	15.13	0.71	2.59
STARO1	NE1/4 9-18N-12W GREELEY	NORTH LOUP	70.00	49.80	0.72	7.56
JACAA1	SW1/4 26-18N-14W VALLEY	NORTH LOUP	136.20	27.85	0.77	8.78
REITE1	SW1/4 3-19N-14W VALLEY	NORTH LOUP	35.50	71.48	0.79	6.00
LUKSU1	SE1/4 22-16N-10W HOWARD	NORTH LOUP	5.60	48.75	0.69	0.57

KEYST1	N1/2NW1/4 7-21N-14W GARFIELD	NORTH LOUP	92.00	36.76	0.83	8.43
GYDKE1	N1/2SW1/4 22-18N-12W GREELEY	NORTH LOUP	66.00	45.22	0.72	6.47
VECST1	W1/2 22-21-18W Loup	NORTH LOUP	104.00	93.28	0.83	24.25
SANDW1	NWSW1/4 2-15-10W Howard	NORTH LOUP	62.00	73.74	0.69	9.42
CONEL1	E1/3SW1/4 30-21-14W Garfield	NORTH LOUP	74.50	49.52	0.80	8.91
WIEKA1	W1/2NE1/4 8-17-13W Valley	NORTH LOUP	41.50	22.42	0.75	2.10
SCHFAR1	NE1/4 20-19-13W Valley	NORTH LOUP	69.40	74.51	0.77	11.95
FOTTR1	Pt N1/2SE1/4 36-18-15W Valley	NORTH LOUP	23.00	15.64	0.77	0.83
EJMJFAR1	S1/2SE1/4 8-18-15W Valley	NORTH LOUP	10.80	18.35	0.79	0.47
PRIAL1	NW1/4 4-16-10W Howard	NORTH LOUP	7.00	22.74	0.70	0.33
PLAWI1	SW 22-19-13 Valley	NORTH LOUP	18.00	69.99	0.75	2.81
KASTR1	SE 18-16-10 & NE 19-16-10	NORTH LOUP	163.00	40.11	0.70	13.69
		Acres Sum	**1996.2**		**Total Depletions**	**204.52**

The 2017 applications showed a smaller impact due to both the 6 fewer applications and smaller size of the fields applied for (58.6 acres average application). The end result using the Coalition's methodologies is a reduction of the basin total by 164.65 AF. Table 14 showcases these applications.

TABLE 17: **NEW GROUNDWATER-IRRIGATED ACRES DEPLETIONS CALCULATED FROM THE 2017 ACRE ALLOCATION**

Application	LEGAL	Basin	ACRES	ELM_SDF	NIR (feet)	Depletion Acre-feet
BABIN1	SW 24-20-6	Beaver	24.50	0.7336	0.59	3.19
DUBLL1	NESW 18-18-4	Beaver	72.00	0.9215	0.64	12.69
JOCDA1	SENE 4-22-7	Beaver	88.30	0.3625	0.62	5.94
JSMFA1	SE 5-20-7	Beaver	82.00	0.5659	0.62	8.62
KORMI1	SE 6-19-4W	Beaver	116.00	0.3105	0.61	6.62
SWADE1	NNW 4-17-4	Beaver	113.00	0.9468	0.65	20.76
WEEED1	SE 23-18-5	Beaver	24.90	0.7137	0.63	3.38
WONLY1	SE 29-21-5	Beaver	105.00	0.2186	0.60	4.10
WONLY2	NW 32-21-5	Beaver	131.00	0.2601	0.59	6.07
ZURDA1	NNW 21-19-5	Beaver	30.20	0.9270	0.61	5.08
ANDCL1	WE17-21-14	North Loup	57.30	0.3314	0.82	4.69
BABTR1	NE 7-17-11	North Loup	22.40	0.3084	0.74	1.54
BROGR1	WSE 25-21-18W	North Loup	57.64	0.9264	0.93	14.83
BURRI1	E 33-22-15	North Loup	46.20	0.4308	0.84	5.00

DAWRA1	W 14-20-14	North Loup	53.00	0.4790	0.78	5.94
HANTR1	NE 19-22-15W	North Loup	119.70	0.4439	0.84	13.31
HULVI1	ENW 5-20-16W	North Loup	149.00	0.6349	0.82	23.38
KOELA1	SW 19-18-14	North Loup	10.80	0.2088	0.78	0.53
KOZMI1	SWNW 13-21-16W	North Loup	29.00	0.6695	0.93	5.40
MEYRI1	SE 6-17-11W	North Loup	7.60	0.2877	0.74	0.49
PETTY1	W2W2 28-16-10W	North Loup	3.50	0.5029	0.69	0.37
PETTY2	NW 27-16-10	North Loup	49.00	0.5500	0.69	5.59
REIDA1	NW 32-20-13	North Loup	46.00	0.5273	0.78	5.66
REITE1	SW 3-19-14W	North Loup	1.30	0.7143	0.79	0.22
WIETIC1	NE 8-17-13	North Loup	24.70	0.2242	0.75	1.25
		Acres Sum	**1464.04**		**Total Depletions**	**164.65**

Combined total of acre-inch impact from allocated groundwater-agricultural uses in the Lower Loup NRD is 369.17 acre-inches. This amount reduces the allowable first 5-year increment to 5,513.83 acre-inches for the Lower Loup NRD.

DEPLETION ACCOUNTING

As mentioned in “Approved Water Transfers” LLNRD Rules and Regulations allow any person to transfer irrigation rights from one location to another if they meet the criteria set forth by the District. Because of the established criteria of not allowing any new net increase in depletions to any stream, the net amount of acre-feet impact should be either relatively similar by a transfer or actually decreased due to any transferring of irrigated acre rights from a low to a higher SDF requires an offset in acres. Transferred from a higher SDF to a lower SDF are only allowed at a 1:1 ratio. The same agricultural methodologies used to apply towards groundwater acre application was applied to transfers. Both the transferring location, where the acres were removed, and the newly developed acres, where the right was transferred to, were assessed. Tables 15 and 16 showcase the net effect of these transfers in acre-inches for the 2016 and 2017-time periods.

From the 2016 transfers, the sum impact of the transferred depletions removed was 157.73 AF, while the impact of the receiving acres with new development was 103.51 AF. The difference and beneficial impact was 54.22 Acre feet back to the basin as a positive gain.

In 2017, the sum impact of the transferred depletions removed was 181.77 AF, while the impact of the receiving acres with new development approved was 119.94 AF. A difference of 61.83 AF was, therefore, calculated back to the system as a positive.

Due to LLNRD Rules and Regulations on transferring irrigated acres, an overall beneficial gain to the Loup Basin in two years of transfers totals 116.05 AF according to LPBC methodology. This is sufficient proof that LLNRD has taken the correct course for allowing transfers and the water banking process is working. The LLNRD will continue to reassess the banking process to find ways to improve the efficiency and streamline reporting through both the IMP and Coalition requirements.

***TABLE 18:* SUMMARY OF ALLOWABLE DEPLETION IMPACT**

Lower Loup Natural Resources District	
Project	**5,883 AF**
2016 New Irrigated Acres	204.52
2016 Transfers	-54.22
2017 New Irrigated Acres	164.65
2017 Transfers	-61.83
2018 New Allowable Depletion	**5,629.88 AF**

GROUNDWATER ELEVATION DATA

One of the LLNRD's primary responsibilities since its inception in 1972 has been collecting groundwater elevation data. Each year, District personnel measure groundwater elevations in both the spring and fall to compare against historical levels. Spring levels are used to report on the status of groundwater, whether increasing or decreasing and to determine if potential changes are needed in the District. Changes can include recommendations against issuing additional irrigated acres. Recommendations also include either allowing or denying transfers into a particular area. Fall levels are used as an indicator of stress that has been placed on the aquifer during the irrigation season. The District has also employed the use of pressure transducers to get continual monitoring at various locations through the NRD. To date, the LLNRD has 61 active transducers across the District recording water levels every 8 hours. In 2016, the LLNRD staff collected groundwater level depths on 420 sites which includes both dedicated monitoring and irrigation wells. The District average fell slightly from 2015 readings by -0.41 feet.

Groundwater level continued in 2017 with 9 additional sites being added across the District, water levels responded positively due to more normal precipitation levels by increasing 0.18 feet. The LLNRD Groundwater Management Plan has indicated 1982 levels as the baseline for action to be initiated, levels in 2017 have stayed well above this trigger point by 2.78 feet. At this time, no additional groundwater regulations or management activities are recommended for groundwater quantity purposes.

NEW DATA COLLECTED OR MODEL/STUDY RESULTS

The LLNRD implemented a plan in the Columbus, Nebraska vicinity to assess available water, develop a localized water budget, identify recharge projects, examine hydrogeology and develop a groundwater model. This project, named Columbus Area Water Resources Assessment (CAWRA) was completed in late

2016 with a recommendation to utilize flows out of the Loup Public Power Canal to offset groundwater depletions occurring due to municipal and industrial pumping. The model was 2 townships in size located around Columbus and consisted of 100-meter by 100-meter grid and had a calibration period of January 1999 through December 2013.

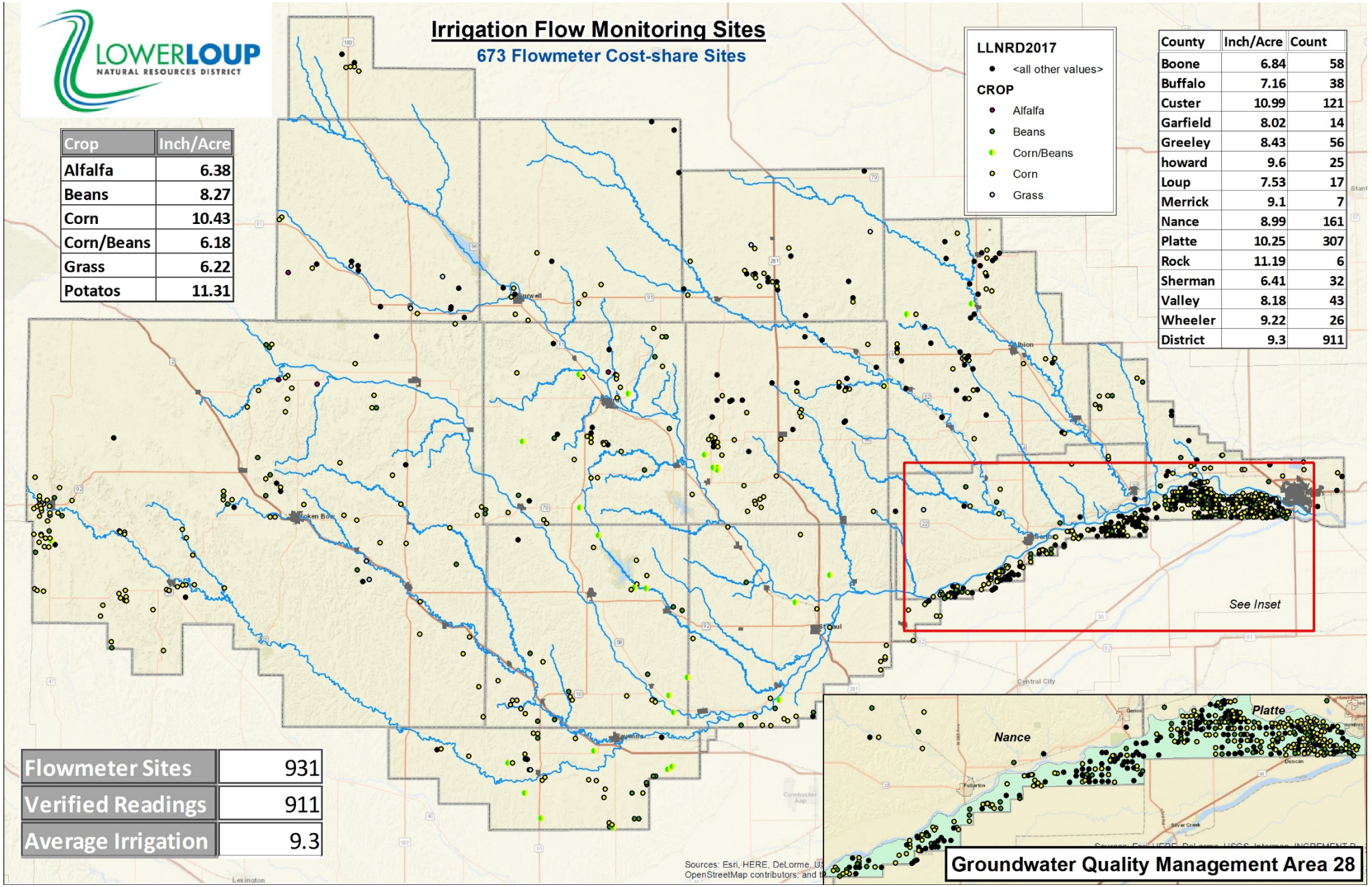
The LLNRD also partnered with the Eastern Nebraska Water Resources Assessment (ENWRA) which includes the NeDNR to collect aerial electromagnetic survey (AEM) data upstream of the Loup/Platte confluence. A report was generated in April 2017 and summarized the AEM survey results and incorporated these results with the existing cross section and Conservation and Survey Division test-holed data, GIS spatial data, and NeDNR well data. The resulting AEM data has been utilized in the CAWRA project model as well as by the LLNRD to identify potential monitoring well sites and recharge locations.

NON-ACTION/REPORTING ITEMS

The Coalition members are responsible for reporting on a number of items that are currently not included as part of the LLNRD day-to-day operations. These Items include:

- Retirement of Groundwater Consumptive Uses
    - Some retirement of groundwater irrigation takes place due to the transfer process. See the section “Transfers” above.
    - The LLNRD does not have a need for wide scale retirement of groundwater consumptive use.
- Stream Flow Accretion activities
    - Transfers allowed by the NRD do not have a negative net impact on the stream and theoretically result in neutral or positive effects on streamflow, see “TRANSFERS” above.
    - Under “NRD MANAGEMENT: WELL AGREEMENTS” the LLNRD is taking proactive measures to reduce surface water allocations, switching those primary sources to groundwater which would result in an immediate reduction to streamflow impacts and likely cause accretion to flows in the impacted stream.
- Stream gage measurements on NRD maintained gages
    - LLNRD has no stream gages under it’s operational jurisdiction at this time, however, the LLNRD is a partner with both the NeDNR and USGS in the operations of various streams across the Loup Basin.

MAP 1: ALL 2017 FLOWMETER READINGS



Crop	Inch/Acre
Alfalfa	6.38
Beans	8.27
Corn	10.43
Corn/Beans	6.18
Grass	6.22
Potatos	11.31

County	Inch/Acre	Count
Boone	6.84	58
Buffalo	7.16	38
Custer	10.99	121
Garfield	8.02	14
Greeley	8.43	56
howard	9.6	25
Loup	7.53	17
Merrick	9.1	7
Nance	8.99	161
Platte	10.25	307
Rock	11.19	6
Sherman	6.41	32
Valley	8.18	43
Wheeler	9.22	26
District	9.3	911

Flowmeter Sites	931
Verified Readings	911
Average Irrigation	9.3