Water for Generations

Jan 9, 2013

2012 NEWBA Demonstration Project

The intent of this demonstration program is to identify, quantify, record and assess the impacts of present day production agricultural. To do this Nebraska Water Balance Alliance (NEWBA), along with a number of producer partners and vendors, have been engaged in a study of current and readily available technologies, practices and bio tics to develop a baseline understanding of consumptions and the implications of the present, and readily available potential, levels of production agricultural development.

Background

Throughout our history, and even to the present, the ability to effectively manage the total water supply has been hampered by inadequate data to make informed decisions. This lack of adequate data has perpetuated faulty water management concepts such as identifying surface and groundwater as water sources and separate water supplies. Because of inadequate data, precipitation, the fundamental water supply and total consumption, the ultimate demand where never appropriately addressed. This shortcoming has led to a totally ineffective notion for water management commonly referred to as a "Shared Pool Resource" that ultimately lead to another issue known as the "Tragedy of the Commons" where no one has or is given the incentive for sustainable management.

In the US, water development began in the west in the early to mid-1800 as diversion from streams for various purposes with supplemental irrigation generally being the primary demand. By the late 1950s groundwater use became another important source of supplemental water. Because of its unpredictable nature as to timing and amount, surface water rights were administered by a measured diversion rate based on the seniority of the application. Because of its localized and generally defined nature, groundwater was regulated by the correlative principle of equally shared shortage. Neither system attempted or, with the data available at the time, could have adequately quantified the resource or its consumption.

A 1985 study produced by Dr. Norm Klocke(UNL- North Platte WCREC) did quantify the annual water consumption of a conventional till, fully irrigated, corn crop at 30" per year. Of that total 21" transpired through the plant and 9" directly evaporated. Since then others, including Dr. Derrel Martin and Dr. Suat Irmak, have added significant new information and insights into the actual and potential consumptions and distribution of the water supply. Dr. Martin, through his development of the CROPSIM model, has been instrumental in quantifying the impacts of land use on water utilization and consumption. Dr. Irmak, through his quantification of evapotranspiration, has improved the understanding of the impacts and potential of land use changes and techniques.

Because of the many enhancements incorporated into present production agriculture, current fully irrigated corn is estimated to consume only about 26" annually. The fact of the matter is that no one knows what current fully irrigated corn, under typical production processes, might need annually because there have not been any efforts focused specifically on identifying this information. A baseline understanding of current irrigation consumption on a broad scale is exactly what this program is intended to establish. Because baselines change daily it will then be

possible to determine how and to what degree new technologies and production agricultural techniques can be successful at conserving energy and water relative to the present condition.

Project Specifics

Project description:

Objectives:

- Promote good stewardship of water resources.
- Promote an emphasis on beneficial consumptive water use (crop needs) as the driver for irrigation decisions rather than acre inch allocations.
- Familiarize producers with use and potential benefits of ET gages and capacitance probes.
- Explore ways to improve power load management with irrigators.
- Form working relationships with several project collaborators to set the stage for more in-depth studies in succeeding year(s).
- Participating growers would provide two pivots and would grow the same crop on each. One pivot would be managed the historical way and the second would be managed utilizing probe technology for irrigation scheduling.

Scope of project:

- Eight growers – Two from each of the four NRD Districts (NPNRD, URNRD, MRNRD, TPNRD).
- Eight growers will be provided with one or two ETGages, rain gauge and two probes for two pivots. Originally there were 8 growers provided with the equipment. Then three more were added that had already made arrangements for their own probe installations. A total of 12 ETGages were installed, one of which was installed at the Pheasant Run Golf Course in Grant to measure evapotranspiration on fairway grass.
- Three weather stations were installed by Aquacheck.
- All irrigated pivots where served by electrical power companies.
- Eight growers were provided with probes; 4 from Aquaview and 4 from Aquacheck.
- Three growers provided their own probes, two were from AquaSpy, one from Aquacheck and one from Water Mark.

Data Collection and Use of Study Results:

- Data collected for the purpose of better understanding water usage and encouraging the implementation of practices that optimizes beneficial water use.
- All data collected will be reported by pivot ID number to maintain anonymity of individual growers.

Project Participant Roles and Responsibilities:

1. **Grower:**
   - Complete an information sheet and sign a consent agreement to allow staff, vendors and power companies to share information including electric meter readings.
   - Request NRCS pre and post residue analysis. (The pre residue measurements were later deleted from the project).
   - Collect rain gauge and ETGage readings and report information to NEWBA staff.
   - Consent to provide other projects participants with read only access to include probe, flow meter and electrical meter data.
   - Share yield data with project participants.
   - Report hail, insect, nutrient and disease problems to the project coordinator.
   - Equipment problems are to be reported to the appropriate vendor.

2. Power Company:

- Read and report weekly energy use and convert to user pumpage.
- Review data to identify possible load management enhancements for the future.

3. NRCS and UNL

- Complete post residue measurements.
- Other counsel.

4. Equipment Dealers and Vendors:

- Coordinate probe placement with the participating grower.
- Install the probes.
- Train and educate the grower on the proper procedures for reading and interpreting the probe data.
- Give advice and counsel during the growing season as requested.
- Remove probes at the end of the growing season.
- Make probe data available to project participants on a read only basis.

5. NRD Participation:

- Recommend and assist with grower selection and site selection.
- Provide ultrasonic testing to determine gallons per minute (GPM) the well is pumping.
- Review data and assist with analysis, (optional).
- Facilitate and support grower educational programs to better understand the benefits of technology in managing their crop production practices.

6. NEWBA

- Participate in site selection.
- Participate is securing funds for the demonstration project.
- Assist in installation and educating growers in ETGage usage and reporting.
- Secure grower consent forms.
- Record and post data from power companies.
- Provide technical support during the growing season.
- Compile data.
- Facilitate a meeting with all project participants to review data and discuss results.

The Following Growers accepted the opportunity to participate:

Each participating grower was given an ID number for his two pivots, one of which was to be irrigated the traditional way and the second one to be irrigated based on probe technology.

	ID #	Legal Description	Soil Type	Acres	Crop
1.a	Lincoln 0,	NE 15-10-33,	Valent Sand,	129.0	Corn
1.b	Lincoln 0,	SW 15-10-33,	Valent Sand,	135.4	Corn
2.a	Dundy1,	SW 13-3-42,	Valent Sand,	129.9	Corn
2.b	Dundy1,	NW 24-3-42	Valent Sand,	132.8	Corn
3.a	Perkins1,	NE 27-10-39,	Valent Loamy Sand	127.5	Corn
3.b	Perkins1,	SW 26-10-39,	Santana V F Sandy Loam	64.5	Corn
4.a	Lincoln 1,	NE 25-12-32,	Valent Sand,	134.4	Corn
4.b	Lincoln 1,	SE 25-12-32,	Valent Sand,	132.0	Corn
5.a	Scottsbluff10,	W 25-23-56,	Alice Fine Sandy Loam,	227.5	Corn
5.b	Scottsbluff10,	NE 26-23-56,	Tripp Fine Sandy Loam,	123.7	Corn

6.a Perkins 3,	SE 22-12-36,	Sarben Loamy V F Sand,	133.4	Corn
6.b Perkins 3,	SW 23-12-36,	Valent Sand,	129.2	Corn
7.a Morrill3,	SW 2-18-49,	Valent Loamy Fine Sand,	126.3	Beets
7.b Morrill2,	SE 11-18-49,	Dailey Loamy Fine Sand,	128.4	Beets
8.a Frontier3,	SE 5-7-27,	Holdrege Silt Loam,	107.8	Corn
8.b Frontier2,	SE 9-7-27,	Holdrege Silt Loam,	129.0	Corn
9.a Lincoln2,	NE 28-13-33	Hersh Soil,	130.0	Corn
9.b Lincoln2,	SE 28-13-33	Valent Sand,	127.5	Corn
10.a Perkins2,	NW 8-10-39,	Mace Silt Loam,	126.5	Corn
10.b Perkins2,	SW 8-10-39,	Kuma Silt Loam,	128.3	Corn
11.a Lincoln3,	SE 12-11-27,	Hoard Silt Loam,	123.5	Soybeans
11.b Lincoln3,	NE 12-11-27,	Hoard Silt Loam,	118.2	Soybeans
12.a Perkins4,	Pheasant Run Golf course		21.9	Fairways
13.a Perkins0,	NE 18-10-38	Santana Silt Loam	119.0	Corn
		Total Acres	3106.5	

.As it turned out, due to the extreme early heat, low humidity and limited rainfall the crop water demand exceeded the design of the pivots and wells. It became apparent by the middle of June that the comparisons had to be abandoned for 2012.

Other partners contributed to the project in time and financial resources:

Contributing partners:

NRD		Staff
Middle Republican NRD,	Dan Smith	Roger Lawson
Upper Republican NRD,	Dirk Dinnel	Nate Jenkins
North Platte NRD,	Ron Cacek	Scott Schamman

The NRD's recommended the growers and participated in the site selections.

Probe Companies	Representative
Aqua Check,	Brad Rathje
Aquaview,	Kylen Hunt
AquaSpy,	Jeff Nodlinski
21st Century,	Justin Childears
Water Mark, UNL Panhandle Station,	Gary Stone
ETGage	John Altenhoffen

The soil probes were provided by the companies listed; which included the responsibility for probe installation, training and education of clients, plus probe removal at the end of the growing season. The 36 to 60 inch probes were installed in May and June to measure and report through telemetry the amount of water available to the plant in real time. Each of the companies provided in-season interpretations of probe data along with graphs and other information related to soil water availability.

Power Companies	Representative	
Midwest Electric	Larry Umberger	Randy Schmitt
McCook Public Power	Jim Florke	
Y-W Electric Coop	Terry Hall	
Wheat Belt Public Power	Jim Weeda	Tim Lindahl
Roosevelt Public Power	Sandra Hendren	Dennis Duffield
Dawson Public Power	Gwen Kautz	Todd Langley
Tri-State Generation & Transmission Assn	Dave Mazour	

The power companies recorded either real time or weekly energy usage by the participating cooperators and converted the data to hours of pivot operation and amount of water applied. To get the amount of water applied, the grower needed to provide the power company with the gallons per minute (GPM) the well pump was delivering to the pivot.

NRCS	**Representative**
North Platte	Mary Reese
Curtis	Kort Kemp
Imperial	Nadine Bishop

NRCS field staff were primary responsible for measuring the post residue measurements. In some cases they also assisted in probe installations.

Other companies	**Representative**	
Olsen Agricultural Labs	Kevin Grooms	Bob Olsen
Simplot Soil Builders	CP Hoehn	Pat Gamet
Appel Consulting	Larry Appel	
Johnson Consulting	Doug Johnson	
Collins Consulting	Dave Collins	
	Brandon Carter	

Olsen Agricultural Labs was responsible for running soil tests for Water Holding Capacity (WHC) and other nutrient tests, including nitrate samples during the season.

The consulting firms provided in-season crop scouting for deficiencies and made recommendations relating to nutrients, diseases, insects, weed pressure and irrigation management. Based on the discussions NEWBA's staff had with the crop consultants, their services should complement our goals and objectives and need to be included in developing future strategies.

Educational Institutions	**Representative**
UNL Business College	Eric Thompson
UNL INAR	Rachel Herpel
UNL Panhandle Research & Ext	Gary Hergert
UNL Panhandle Research & Ext	Gary Stone
UNL West Central Research & Ext	Bob Kein
UNL Biological Systems Engineering	Derrel Martin
UNL Biological Systems Engineering	Saut Irmak
UNL Biological Systems Engineering	Dean Eisenhouer
UNL Southeast Research & Ext	Gary Zoubek
UNL Natural Resources	Jim Goeke
UNL Drought Mitigation Center	Cody Knutson
KSU Kansas State Ag Research	Norm Klucke

The UNL Business College (Bureau or Research) provided information showing the potential negative economic impacts of reduced irrigation in 3 counties in Nebraska.
The UNL Biological Systems Engineering Department provided much of the information and recommendations needed to properly design the crop consumptive water use tables for use by the cooperators.
UNL Natural Resources provided information and data on water movement in the soil profile and surface runoff.

UNL Panhandle and Southeast Research and Extension provided the technical assistance and a web site for the Evapotranspiration gauge readings along with actual consumptive use by the crop at various stages of growth.
UNL Drought Mitigation Center is providing a framework for future planning and design to better prepare for and adjust water management practices based on historical events and weather projections in the future.
Kansas State University Agricultural Research Center in Garden City, KS has provided NEWBA the basic information and data on how to measure off-season aquifer recharge. This information is valuable in helping to do a better job in harvesting and storing precipitation.
UNL INAR's role is to provide coordinated access to research and information.

Equipment and services provided for use in the Demonstration Project

Each grower participating in the project signed an agreement identifying what equipment and services would be made available for the project. The participant also agreed to give access to the site allowing vendors and NEWBA staff to preform duties such as installing probes; preforming maintenance; and taking residue samples, soil samples and meter readings.

Equipment was provided to the following cooperators

ID #	Power Co service	ET Gage	Probes	Weather Station	Furnished by:
1.a Lincoln 0,	Midwest Elect,	1	Aquaview		NEWBA
1.b Lincoln 0,	Midwest Elect		Aquaview		NEWBA
2.a Dundy1,	Y-W Elect	1	Aquacheck	Aquacheck	NEWBA
2.b Dundy1,	Y-W Elect		Aquacheck		NEWBA
3.a Perkins1,	Midwest Elect	1	AquaSpy		Owner
3.b Perkins1,	Midwest Elect		AquaSpy		Owner
4.a Lincoln 1,	Dawson PP	1	Aquaview		NEWBA
4.b Lincoln 1,	Dawson PP		Aquaview		NEWBA
5.a Scottsbluff10,	Roosevelt PP	1	Aquacheck		NEWBA
5.a Scottsbluff10,	Roosevelt PP		Water Mark		UNL Panhandle
5.b Scottsbluff10,	Roosevelt PP		Aquacheck		NEWBA
5.b Scottsbluff 10,	Roosevelt PP		Water Mark		UNL Panhandle
6.a Perkins 3,	Midwest Elect	1	AquaSpy		Owner
6.b Perkins 3,	Midwest Elect		AquaSpy		Owner
7.a Morrill3,	Wheatbelt PP	1	Aquacheck	Aquacheck	NEWBA
7.b Morrill2,	Wheatbelt PP	1	Aquacheck		NEWBA
8.a Frontier3,	McCook PP	1	Aquaview		NEWBA
8.b Frontier2,	McCook PP	1	Aquaview		NEWBA
9.a Lincoln2,	Dawson PP		Aquacheck	Aquacheck	Owner/NEWBA
9.b Lincoln2,	Midwest Elect		Aquacheck		Owner/NEWBA
10.a Perkins2,	Midwest Elect	1	Aquacheck		NEWBA
10.b Perkins2,	Midwest Elect		Aquacheck		NEWBA
11.a Lincoln3,	Dawson PP	1	Aquaview		NEWBA
11.b Lincoln3,	Dawson PP		Aquaview		NEWBA
12.a Perkins4,	Pheasant Run	1			NEWBA
13.a Perkin0,	Midwest Elect		Aquacheck	Aquacheck	Aquacheck

Perkins1, Perkins3 and Lincoln2 were added to the Demonstration Project after selection of growers for the project was closed. These three cooperators volunteered to participate even though they did not receive any equipment. NEWBA did agree to provide the same staff services as those that were included

originally. It was a good decision as it gave NEWBA additional information to evaluate. The ETGage at the Pheasant Run Golf Course provided good in-season water use by the fairways and will be continued in 2013. Perkins0 did not have two pivots available and could not participate in the Demonstration Project; however, it did participate in the ETGage, flow meter, and electric meter readings. (The data is not included in the Demonstration Project report.)
The Demonstration Project Coordinator received compensation for travel and out of pocket expenses as it was included in the budget along with the identified equipment.

Equipment Installation dates

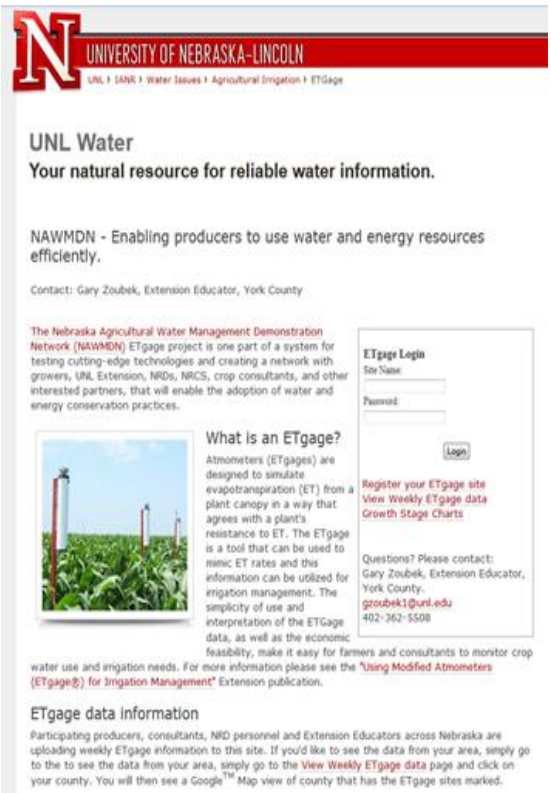
ID#	ETGage Installation	Probe Installation	Length of Probe	Reporting Dates	Residue Cover	Weather Station
1.a Lincoln 0,	5-8-12	5-29-12	40”	Wed	35%	
1.b Lincoln 0,	5-8-12	5-29-12	40”	Wed	35%	
2.a Dundy1,	5-11-12	6-13-12	40”	Fri	13%	
2.b Dundy1,	5-11-12	6-13-12	40”	Fri	12%	5-16-12
3.a Perkins1,	5-5-12	6-1-12	40”	Mon	62%	
3.b Perkins1,	5-5-12	6-1-12	40”	Mon	60%	
4.a Lincoln 1,	5-7-12	6-12-12	40”	Mon	65%	
4.b Lincoln 1,	5-7-12	6-12-12	40”	Mon	35%	
5.a Scottsbluff10,	5-9-12	6-7-12	40”	Wed	N/A	New Develop
5.a Scottsbluff10,	5-9-12	6-12-12	36”	N/A	N/A	
5.b Scottsbluff10,	5-9-12	6-7-12	40”	Wed	N/A	Grazed heavy
5.b Scottsbluff10,	5-9-12	6-12-12	36”	N/A	N/A	
6.a Perkins 3,	5-19-12	6-27-12	40”	Tue	N/A	Late addition
6.b Perkins 3,	5-19-12	6-27-12	40”	Tue	N/A	Late addition
7.a Morrill3,	5-9-12	5-7-12	60”	Wed	N/A	5-17-12
7.b Morrill2,	5-9-12	5-7-12	60”	Wed	N/A	
8.a Frontier3,	5-7-12	6-12-12	40”	Mon	60%	
8.b Frontier2,	5-7-12	6-12-12	40”	Mon	35%	
9.a Lincoln2,	Existing	May ?	40”	Mon	62%	4-20-12 ?
9.b Lincoln2,	Existing	May ?	40”	Mon	63%	
10.a Perkins2,	5-5-12	6-6-12	40”	Tue	35%	
10.b Perkins2,	5-5-12	6-6-12	40”	Tue	34%	
11.a Lincoln3,	5-7-12	5-29-12	40”	Mon		
11.b Lincoln3,	5-7-12	5-29-12	40”	Mon		
12.a Perkins4,	5-22-12					
13.a Perkins0,	Existing	7-2-12	36”	Daily	22%	5-16-12

Morrill2, & Morrill3 had beets planted before any equipment was installed.
Lincoln2 had all the equipment installed before it was added to the project. Perkins3 also came on board late. Perkins4 (Pheasant Run Golf Course) and Perkins0 were not part of the original project and did not report to NEWBA.

Post residue cover measurements were taken after the crops had emerged. Residue cover for 2012 was very important because it decreased the soil temperature and helped to reduce early season scalding on corn because the soil near the surface was wetter.

Data Collection for ETGages

The ETGage is calibrated in inches and the participating grower agreed to read the gauge once a week including how much precipitation was received. This information, including the crop stage of growth, was reported to the NEWBA staff. The NEWBA staff would log into the UNL ETGage web site: http://elkhorn.unl.edu/ETGage/index.jsp . Then they would log into the **site Name** and **Password** for the appropriate gauge site and post the precipitation received, ETGage change in inches from the previous week and the stage of growth. The UNL program would then calculate the amount of consumptive water that was used for the week.



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UNL Water

Your natural resource for reliable water information.

NAWMDN - Enabling producers to use water and energy resources efficiently.

Contact: Gary Zoubek, Extension Educator, York County

The Nebraska Agricultural Water Management Demonstration Network (NAWMDN) ETgage project is one part of a system for testing cutting-edge technologies and creating a network with growers, UNL Extension, NRDs, NRCS, crop consultants, and other interested partners, that will enable the adoption of water and energy conservation practices.

What is an ETgage?

Atmometers (ETgages) are designed to simulate evapotranspiration (ET) from a plant canopy in a way that agrees with a plant's resistance to ET. The ETgage is a tool that can be used to mimic ET rates and this information can be utilized for irrigation management. The simplicity of use and interpretation of the ETGage data, as well as the economic feasibility, make it easy for farmers and consultants to monitor crop water use and irrigation needs. For more information please see the "Using Modified Atmometers (ETgage®) for Irrigation Management" Extension publication.

ETgage Login

Site Name:

Password:

Login

Register your ETgage site

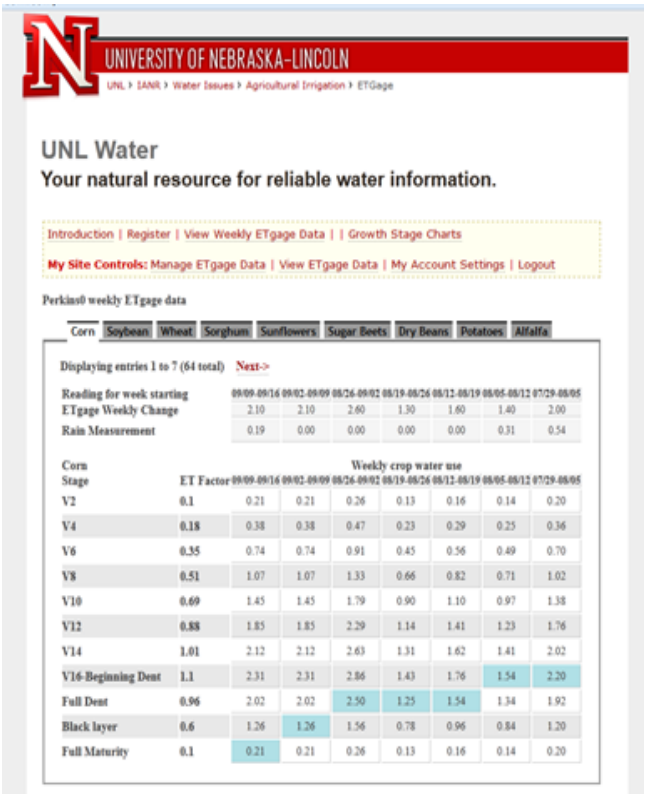
View Weekly ETgage data

Growth Stage Charts

Questions? Please contact:
Gary Zoubek, Extension Educator, York County.
gzoubek1@unl.edu
402-362-5508

ETgage data information

Participating producers, consultants, NRD personnel and Extension Educators across Nebraska are uploading weekly ETgage information to this site. If you'd like to see the data from your area, simply go to the to see the data from your area, simply go to the View Weekly ETgage data page and click on your county. You will then see a Google™ Map view of county that has the ETgage sites marked.



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UNL Water

Your natural resource for reliable water information.

Introduction | Register | View Weekly ETgage Data | | Growth Stage Charts

My Site Controls: Manage ETgage Data | View ETgage Data | My Account Settings | Logout

Perkins0 weekly ETgage data

Corn | Soybean | Wheat | Sorghum | Sunflowers | Sugar Beets | Dry Beans | Potatoes | Alfalfa

Displaying entries 1 to 7 (64 total) Next->

Reading for week starting	09/09-09/16	09/02-09/09	08/26-09/02	08/19-08/26	08/12-08/19	08/05-08/12	07/29-08/05
ETgage Weekly Change	2.10	2.10	2.60	1.30	1.60	1.40	2.00
Rain Measurement	0.19	0.00	0.00	0.00	0.00	0.31	0.54

Corn Stage	ET Factor	Weekly crop water use 09/09-09/16	09/02-09/09	08/26-09/02	08/19-08/26	08/12-08/19	08/05-08/12	07/29-08/05
V2	0.1	0.21	0.21	0.26	0.13	0.16	0.14	0.20
V4	0.18	0.38	0.38	0.47	0.23	0.29	0.25	0.36
V6	0.35	0.74	0.74	0.91	0.45	0.56	0.49	0.70
V8	0.51	1.07	1.07	1.33	0.66	0.82	0.71	1.02
V10	0.69	1.45	1.45	1.79	0.90	1.10	0.97	1.38
V12	0.88	1.85	1.85	2.29	1.14	1.41	1.23	1.76
V14	1.01	2.12	2.12	2.63	1.31	1.62	1.41	2.02
V16-Beginning Dent	1.1	2.31	2.31	2.86	1.43	1.76	1.54	2.20
Full Dent	0.96	2.02	2.02	2.50	1.25	1.54	1.34	1.92
Black layer	0.6	1.26	1.26	1.56	0.78	0.96	0.84	1.20
Full Maturity	0.1	0.21	0.21	0.26	0.13	0.16	0.14	0.20

Probe installation and calibration

Capacitance and ceramic probes ranged in length from 36 to 60 inches in length with most being able to measure changes every 4 inches along the probe either with a physical sensor at each location or through mathematical interpolation. The capacitance and ceramic probes are normally installed in the row after the crop is planted. If it is

corn, between the 2nd and 8th leaf stage is considered satisfactory. Also field traffic is minimal and does not interfere with probe functions. The probes also have telemetry mounted within several feet from the probe itself and elevated on a post high enough to get radio, telephone or satellite reception and still be under the truss rods of the center pivot. One vendor has developed an application that uses the results from the probe in a relative fashion. The refill point (moisture level where the plants water uptake has reduced below optimum level) is estimated based on soil type using a percentage below field capacity. During the growing season, the actual refill point may be more accurately set based on actual consumption signatures. The dry end of the range is where the plant is unable to extract any more moisture from the soil around the sensor which indicates the permanent wilting point. The range between field capacity and permanent wilting point is commonly referred to as Plant Available Water (PAW) and is often described as moisture release curves. We need to remember that each crop has different moisture extraction rates so the curves will vary. A good example is: Wild sunflowers and Russian thistle seem to look healthy when everything else is drying up.

Dry set installations

Probes installed using dry set use a tripod with a tube driven to the ground to the probe depth. The soil that is inside the tube is then augured out and the components of the probe are installed. The objective is to keep the soil around the probe as close to the true soil strata as possible.

Slurry set installations

Probes installed using the slurry method drill a hole larger than the probe to the depth the probe is to be placed. Before the probe is placed in the hole, slurry is prepared from the soil and mixed with water before pouring the contents into the hole. After the slurry is in the hole the probe is pushed down into the hole to make good contact with soil profile.

Probe calibration is the same as with the dry installations. However, a slurry install requires a drying period of a couple days to allow the composite mixture to match the content of the true soil strata before accurate readings can be obtained or if complete drainage is observed during the growing season, the field capacity is accurately determined.

Calibrating the probe

There are a number of ways to calibrate a probe. Some using the dry installation may pour water around the probe and wait a couple of days to let the soil find the equilibrium or they can wait for irrigation or precipitation to determine the field capacity. The refill mark is then set at a percentage below the full mark using the soil type or classification to determine where the wilting point is at. The soil type and water holding capacity of a soil is available from the NRCS Soil Survey Maps. A number of probe companies are recommending that the field should be Electromagnetic mapped to improve accuracy and to help with proper probe placement.

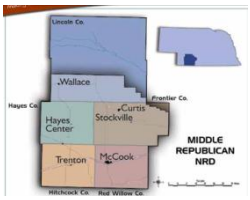
Ceramic probes are designed to have a separate ceramic tip at the end of each probe and are generally placed in the soil at one, two, three or four foot depths with a reading at each depth. These sensors apply a small electric current to measure resistance. They measure soil tension, so it is very important that good soil contact is maintained.

Water Holding Capacity Measurements generally are in either in percentage or converted to inches.
Converting to inches of water can only accurately be accomplished when actual soil type is known for each layer that the probe is measuring.

Flow meters

The following Natural Resource and Conservation Districts (NRD) participated in the Demonstration Project this year, some of which required flow meters on all irrigation wells and are read at least once a year to determine how much water was pumped. An issue that was identified is how the flow meters are calibrated. Some were in gallons (or gallons with a multiplier of 1, 10, 100 or 1000), Acre feet, or Acre inches. To prevent error it would have been best if all meters would have been calibrated in acre inches. If it's in acre inches it eliminates additional calculations to get to inches/Acre applied. All that needs to be done is divide the acre inches by the acres in the field and the result is inches applied per acre.

The Upper Republican NRD, (URNRD) (Flow meters required)
The URNRD requires flow meters on all irrigation wells and are read annually to measure how much water was used in the past year. The URNRD also has an allocation of 13 inches per year and are pooled into a 5 year cycle for a total of 72 inches for the five years. A new allocation period is being prepared for 2013 and has not been set by the Board of Directors at the time of this writing.



Middle Republican NRD, (MRNRD) (Flow meters required)
The MRNRD also requires flow meters on all irrigation wells with an allocation of 12 inches per year. The NRD also has a five year pooling arrangement that allocates a total of 60 inches. It also is in review for 2013.

North Platte NRD (NPNRD) (Flow meters required)

The NPNRD requires flow meters on all wells. The NPNRD has two separate ground water allocations; one in the overappropriated area of the NRD and the other in the Pumpkin Creek Basin. The allocation in the overappropriated area is 56 inches over a four year period. Water year 2013 is the final year of this allocation period. The allocation in the Pumpkin Creek basin is 36 inches over a three period. There are two years left in this allocation period. Fields receiving surface water from the Pathfinder Irrigation District or any irrigation district have an allocation for ground water if they are located in the overappropriated area. Lands located in the fully appropriated area of the NRD do not have an allocation of ground water and flow meters are not required to be in place.

Power Company energy measurements

Power companies have a unique problem: they want sell all the energy they can to produce revenue, but they would like to have it evenly distributed throughout the year. Power companies require a tremendous amount of capital investment and must design the system to meet the maximum expected demand. If demand is extremely high during certain times of the year, such as irrigation during the crop growing season, the system needs to be designed to meet that requirement. The energy purchased from the transmission and production supplier bills on peak demand as the system must be designed for that required capacity. If power companies can lower the peak demand, this lowers the cost per kilowatt hour. To keep the demand charges down, a number of power companies have developed programs to measure energy use by each electric irrigation motor in real time. This information is then used to encourage users to lower demand to save them money while helping the power companies better manage demand and reduce both power and operating costs.

If the irrigation user gives the power company the Gallons Per Minute (GPM) the well is pumping and the acres in the field they can calculate how much water was applied to the field within 90% plus accuracy in real time.

The calculation is as follows:
Kilowatt hour reading/ Demand kW = Hours of operation X Minutes of operation X GPM =gallons applied /27.154/Acres in the field = Inches applied.
One of the objectives was to see how close the power company calculations came to flow meter readings.

Water Holding Capacity soil testing (WHC)

Sample ID	Depth	H20 % 15 BAR	H20 % 1/3 BAR	Available Water in Inches
SW QTR 23 12 36	0-12	2.52	5.10	0.31
SW QTR 23 12 37	12-24	3.22	6.67	0.41
SW QTR 23 12 38	24-36	3.65	7.22	0.43
SW QTR 23 12 39	36-60	4.00	8.30	1.03
SE QTR 22 12 36	0-12	4.57	7.75	0.38
SE QTR 22 12 37	12-24	3.19	5.78	0.31
SE QTR 22 12 38	24-36	3.07	6.16	0.37
SE QTR 22 12 39	36-60	3.01	5.83	0.68
SW QTR 2 18 49	0-12	4.12	7.57	0.41
SW QTR 2 18 50	12-24	4.03	8.29	0.51
SW QTR 2 18 51	24-36	3.18	6.98	0.46
SW QTR 2 18 52	36-60	3.09	5.35	0.54
SE QTR 11 18 49	0-12	3.31	5.02	0.21
SE QTR 11 18 62	12-24	3.22	4.78	0.19
SE QTR 11 18 66	24-36	4.37	7.84	0.42
SE QTR 11 18 67	36-60	6.82	10.36	0.85
	0-12	18.19	28.57	1.25
	12-24	16.35	28.28	1.43
	24-36	16.58	26.62	1.21

Most Water Holding Capacity (WHC) calibrations for probes is based on a NRCS Soil Survey map that can be accessed on line at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm . After accessing the website, type in the legal description of the field and follow the instructions. Knowing when the latest soil surveys were done will help determine the accuracy of the information. A number of probe manufacturers are recommending Electro-magnetic mapping to increase the accuracy and to better identify where the capacitance probe should be located.

One of the issues raised by the potential cooperators was how accurate the probes were in calibrating the probes to WHC. It was decided to take soil samples next to the probe at 1 Ft increments to a depth of 5 Ft and then compare the information with the Soil Survey maps. This was done and the information is available in the Project Results area.

Nitrate testing

Nitrogen movement in the soil profile is an area that needs more attention. Nitrates move in the soil with the wetting front of water and move either up or down. It is desirable to keep the nitrates in the active root growing areas of the soil. Soil filled with water above field carrying capacity causes nitrogen to de-nitrify and volatilize into the atmosphere and is lost to the plant. Also a soil filled above field capacity moves water down through the soil taking nitrates with it. Many times the nitrates move beyond the root zone and eventually into the aquifer which is undesirable and a waste of nutrients. Again, the tests were taken in 1 Ft increments to a depth of 5 Ft. The first tests were taken at the time the probes were installed; the second set was taken in the middle of the growing season and the last set was taken at the end of the season when the crop was mature and ready for harvest. The last set of tests was dug to a depth of 7 Ft. The test results are located in the Project Results area.

Olsen's Agricultural Laboratory, Inc.
210 East 1st / PO Box 370 / McCook, Nebraska 69001
Office: 308-345-3670 / FAX: 308-345-7880
www.olsenlab.com

NAME : [redacted] DATE RECEIVED: 07/03/2012 DATE REPORTED: 07/09/2012

SOIL TEST RESULTS

SAMPLE IDENTIFICATION	Depth Inches	pH 1:1 Soil	pH Buffer Woodruff	LIME REC T/A 60% ECCE Legume	LIME REC T/A 60% ECCE Non Legume	EL	SOLUBLE SALTS mod. SP mmhos/cm	OM LOI %	NITRATE-N (FIA) ppm	NITRATE-N (FIA) lbs/A	PHOSPHORUS P1 ppm	PHOSPHORUS Bicarb ppm	PHOSPHORUS P2 ppm	PHOSPHORUS M2 ppm	PHOSPHORUS M3 ppm
NW QTR 8 10 39	0-12	5.6	6.5	2.5	0.0			2.3	37.5	135					
NW QTR 8 10 39	12-24	6.6	7.0						8.4	30					
NW QTR 8 10 39	24-36	7.5							14.7	53					
NW QTR 8 10 39	36-60								8.3	60					

NH4OAc (Exchangeable) K ppm	Ca ppm	Mg ppm	Na ppm	DTPA Zn ppm	Fe ppm	Mn ppm	Cu ppm	BORON Sorbitol ppm	EST. CATION EXCHANGE CAPACITY (CEC) me/100g	% SATURATION BASE	H	Ca	Mg	K	Na
463	1850	319	29						18.2	73	27	50	15	7	1
383	2650	412	40						17.8	100	0	74	19	6	1
525	2890	460	37						19.8	100	0	73	19	7	1

Weather Stations

Four weather stations were installed and three were next to ETGages.
One of the objectives is to compare the weather station ET with the ETGages to see if differences exist. The weather stations were able to measure the following information every 15 minutes:
The weather Temperature, Wind speed, Relative humidity, Rainfall, Dew point, Solar Radiation, ET. Weather stations will be very valuable in real time measurements to help management.

What data was collected and time frame:

ETGage

The ETGages were read once a week and they reported to NEWBA the Evapotranspiration, stage of growth and rainfall. The stage of growth information was posted on the UNL ETGage website where the information was used to calculate the actual crop use. These readings were taken weekly during the active growing season to determine how much the crop used.

Flow Meters

Those growers that had flow meters either read them at the same time they read the ETGages or periodically during the growing season. The NRDs read them at the end of the year or at the request of the grower. Those that did not have flow meters could request ultrasonic testing during the pumping season. The purpose of the flow meter is to measure how much water is applied during the pumping season

Power Company

Power company energy readings were either daily or weekly depending on the software capabilities of the power company. The information was gathered during the active pumping season. The data was used to calculate how much water was applied and how much energy was used.

Capacitance and Ceramic Probes

The capacitance and ceramic probes were installed early in the growing season and removed before harvesting the crop. The capacitance probe readings were available in real time and the ceramic probe data was available when the data loggers downloaded the information. The objective was to determine how much water was available to the crop at a given time during the season.

Weather Stations

The weather station data is available in 15 min increments, any time during the year.

What changes or additions would have been useful in 2012?

- ETGages should have been installed prior to planting, May 1st or sooner.
  All cooperators should have read and reported the data on the same day.
  Tipping bucket rain gauges should have been added to the telemetry at the probes so that the total application could have been measured.
  One idea would be to use security cameras to measure stage of growth and runoff.
  All cooperators should start the season for reading the ETGages on the same day.
- Flow Meters should have been read and reported the same day as the ETGages.

- Power company users should have had access to real time measurements.
- Probe manufactures needed to install the probes earlier in the season.
- Add an intern that was capable of helping in the field meter readings, soil sampling and date collection.

Project Results

Data from the cooperators, power companies and vendor probes were collected on a weekly basis and reported to NEWBA staff after readings were taken.

Summary of the 2012 reports

Grower Comparisons

			Grower will provide				UNL	NRD's	Power Companies		
A	B	C	D	E	F	G	H	I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET reading To Date	Rainfall to date	Stage of Growth end Mon	Consumptive Crop use to date	Flow-Meter inches Applied	Date of Last Report	hours irrigated	Inches applied
Lincoln0	Corn	129.1	9/13/2012	30.90	0.00	B Layer	16.70	21.77	9/13/2012	1589.93	20.39
Lincoln0b	Corn	135.4	9/13/2012	30.90	0.00	B Layer	16.70	21.36	9/5/2012	1612.19	20.67
Dundy1	Corn	132.8	8/27/2012	26.90	0.00	R-1	0.00	21.42	9/28/2012	1358.98	22.05
Dundy1b	Corn	129.0	8/27/2012	0.00	0.00	R-1	0.00	21.29	9/28/2012	1687.14	16.09
Perkins1	Corn	127.5	9/21/2012	27.80	4.22	Mature	15.73	17.75	11/7/2012	1565.35	18.99
Perkins1b	Corn	64.0	9/21/2012	27.80	4.22	Mature	15.73	21.75	11/7/2012	1353.15	19.68
Lincoln1	Corn	134.4	9/4/2012	30.50	0.00	R-5	21.07	N/A	9/7/2012	1812.17	30.18
Lincoln1b	Corn	132.0	8/27/2012	30.50	0.00	R-5	21.07	N/A	9/14/2012	1702.24	29.92
ScottsBluff10	Corn	227.5	8/23/2012	0.00	0.00	R-3	21.56	15.89	9/13/2012	2273.23	25.39
ScottsBluff10	Corn	123.7	8/16/2012	0.00	0.00	R-3	0.00	22.66	9/15/2012	2256.31	25.20
Perkins3	Corn	133.4	7/30/2012	0.00	0.00	Milk	0.00	21.60	9/12/2012	1547.99	21.18
Perkins3	Corn	129.2	7/30/2012	0.00	0.00	Milk	0.00	22.73	9/6/2012	1605.33	21.28
Morrill2	Beets	126.3	9/26/2012	43.90	2.05	100 % Cov	27.60	17.40	9/30/2012	1487.46	19.52
Morrill3	Beets	128.4	9/26/2012	44.70	2.15	100 % Cov	28.15	19.49	9/30/2012	1849.74	20.69
Frontier0	Corn	145.0	7/23/2012	0.00	0.00	R-1	0.00	16.15	9/2/2012	1148.23	19.25
Frontier1	Corn	213.7	7/23/2012	12.10	0.00	R-1	0.00	14.72	9/9/2012	1431.06	17.02
Lincoln2	Corn	130.0	9/3/2012	28.23	2.71	F Mat	18.89	27.70	9/7/2012	1607.91	22.55
Lincoln2b	Corn	127.5	9/3/2012	28.22	2.71	F Mat	18.83	25.72	8/31/2012	1754.75	24.61
Perkins2	Corn	126.5	8/31/2012	36.40	0.00	B Layer	18.50	19.39	9/8/2012	1580.51	24.24
Perkins2b	Corn	128.3	8/31/2012	36.40	0.00	B Layer	18.50	14.86	9/2/2012	1476.56	19.07
Lincoln3	Soybea	123.5	9/3/2012	32.90	0.00	R-7	25.81	N/A	9/30/2012	1414.16	18.73
Lincoln3b	Soybea	118.2	9/3/2012	32.90	0.00	R-7	25.81	N/A	9/7/2012	1334.91	18.59
Total Acres		2965.4		22.78	0.82		14.12	20.20		1611.33	21.60

N/A blanks indicate no flow meters. TPNRD does not require flow meters.

Legend for the above chart:

A = UNL Cooperator ID. It identifies the county the ETGage is located in.
B = Identifies the crop grown under the pivot.
C = Number of pivot irrigated acres in the field.
D = The last day of the month an ETGage reading was reported to the NEWBA staff.
E = Total evapotranspiration for the month *.
F = Rainfall for the month*.
G = Stage of crop growth reported to NEWBA staff*.
H = Calculated consumptive use by the crop. The calculation is derived from the UNL ETGage website.

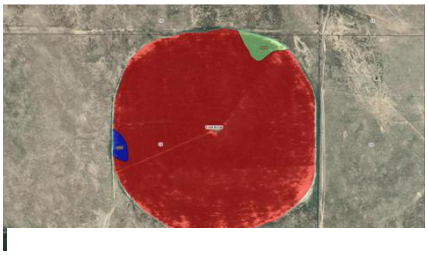
I = Flow meter readings taken during the month and calculated to show how much water was applied per acre*.
J = Date of last electric meter reading reported to the NEWBA staff*.
K = Power company calculated hours of pivot operation.
L = Power company calculations showing the amount of water applied to the field in inches/A

* = A number of readings were not on the last day of the month. Calculations are then based on the latest reading

Capacitance probe summary reports.

Lincoln0 capacitance summary report

Lincoln0 NE ¼ 15-10-33



Soil Type

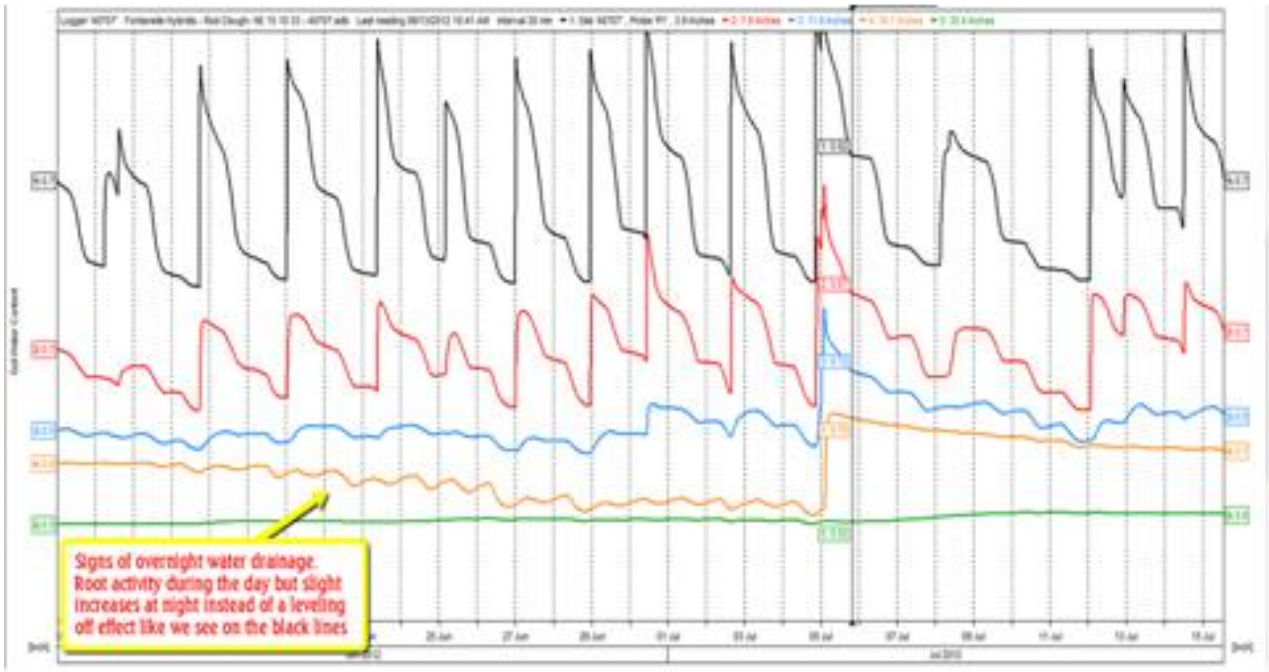
Valent Sand

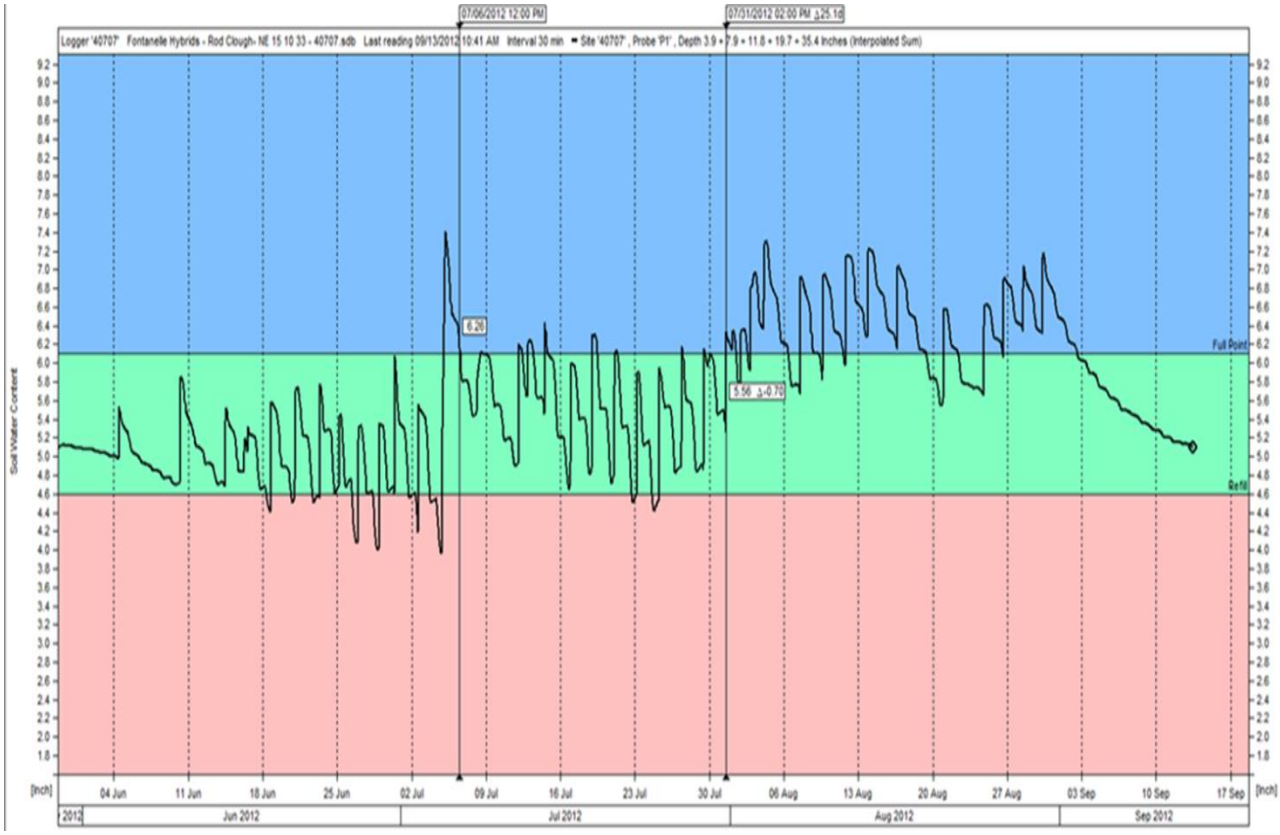
Water Holding Capacity

Inches	Soil Survey Map	Soil test Lab
0-12”	**.70”**	.31”
0-24”	**1.40”**	.66”
0-36”	**2.80”**	.96”
0-60”	**4.20”**	1.61”

Lincoln0 Farms

NE 15-10-33





		Consumptive crop water use, flow meter readings and power company caculations											
			Grower will provide				UNL	Flow meter report		Power Companies		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/29/2012	3.50	0.60	V-4	1.03			5/30/2012	43.48	0.53
Lincoln 0	Corn	129.1	6/28/2012	12.20	0.60	15-16 leaf	3.45			6/30/2012	425.62	5.21
Stratter I			7/17/2012	19.90	0.95	R-1	5.60	7/26/2012	12.55	7/31/2012	1006.65	12.32
NE 1/4 15-10-33			8/30/2012	27.70	1.60	Mature	15.38			8/31/2012	1567.62	19.19
			9/13/2012	30.90	1.60	B layer	16.70	9/13/2012	21.77	9/7/2012	1590.76	19.47

Lincoln0
NE 15 10 33

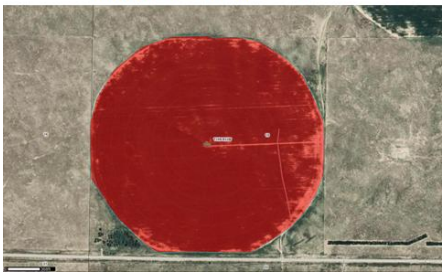
38 Rotations made in this season. Total water application was 21.77'/Acre. The average application/rotation was .57 inches/Acre.

6-04-12: First irrigation event. The beginning of a long season.
6-17-12: First 20" root activity. Pivot appears to be on a 2 day rotation.
7-04-12: Big irrigation event. However you can see in the graph (figure 1) that all root activity stopped at the 20" sensor level. 20" sensor showed a large increase in moisture but it only drained out and wasn't used by the plant.
7-16-12: Roots become active again at the 20" sensor level.
7-31-12 - 8-04-12 Pivot was sped up to a 24hr rotation. This caused a rise in the soil profile yet it also caused the roots at the 20" level to remain fairly inactive the rest of the season. Only slight root activity steps but mostly areas of up and down drainage.
8-30-12: Last irrigation event.
Period between 7-8 and 7-31 showed the most root activity in all areas.

Recommendations for 2013:

- Map the Field. This soil appears to be extremely light soil. By mapping the fields we can be better at probe placement. As low water holding capacity as this field has, it will be important to optimize water. With a probe placed to the majority WHC area the more accurate we will be with scheduling irrigation. Especially when we do begin to get rain again.
- Consider VRI. Allow the probe to tell us how much and when to water. Allow the VRI to apply the right amount to the average WHC under the pivot at any given time. With low WHC this can potentially generate tremendous water and energy savings.
- Allow the field to dry down a little. This will allow the deeper roots to become more active. However it will be important to keep this field fairly full as the WHC is low. Precise management appears to be very important.
- Be cautious if pre-watering. It appears the deep soil may still have some moisture in it. Pull core samples before pre-watering. Top 12" will probably be dry but checking the subsoil will be important.

Lincoln0 SW ¼ 15-10-33



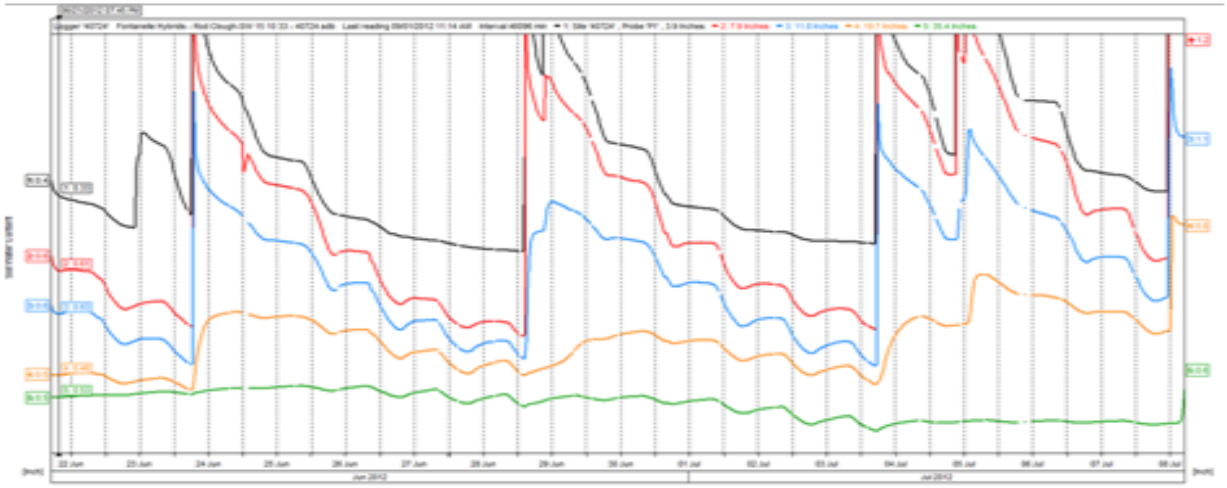
Soil Type

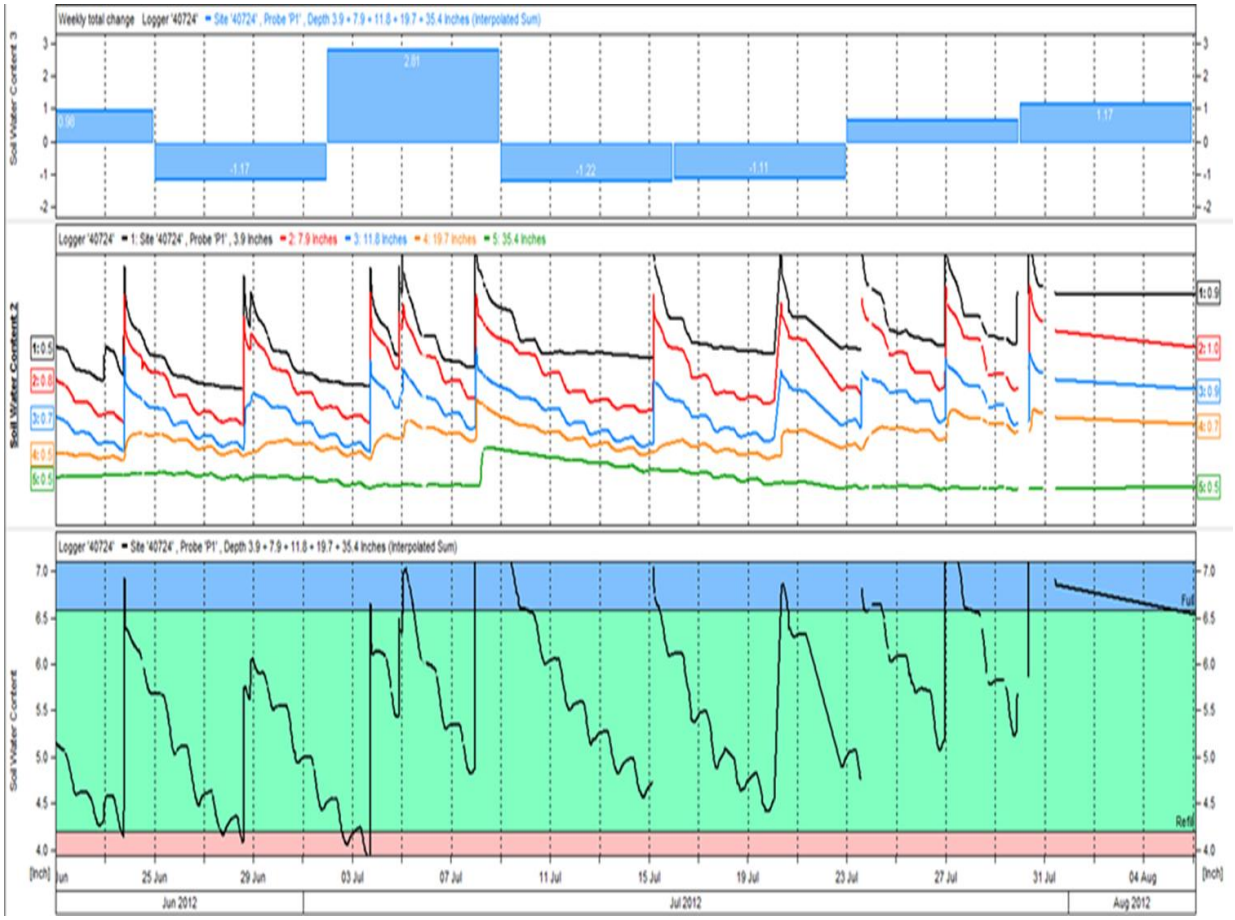
Valent Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil Test Lab
0-12"	**.74"**	.26"
0-24"	**1.43"**	.59"
0-36"	**2.80"**	.85"
0-60"	**4.20"**	1.59"

Lincoln0 Farms
SW 15-10-33





		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter report		Power Companies		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/29/2012	3.50	0.60	V-4	1.03			5/30/2012	43.48	0.53
Lincoln 0b	Corn	135.4	6/28/2012	12.20	0.60	15-16 leaf	3.45	6/21/2012	2.21	6/30/2012	455.63	5.96
Stratter II			7/17/2012	19.90	0.95	R-1	5.60	7/26/2012	11.60	7/31/2012	1049.22	13.44
SW 1/4 15-10-39			8/30/2012	27.70	1.60	Mature	15.38			8/31/2012	1589.11	20.37
			9/13/2012	30.90	1.60	B layer	16.70	9/13/2012	21.36	9/5/2012	1612.19	20.67

Lincoln0
SE 15 10 33

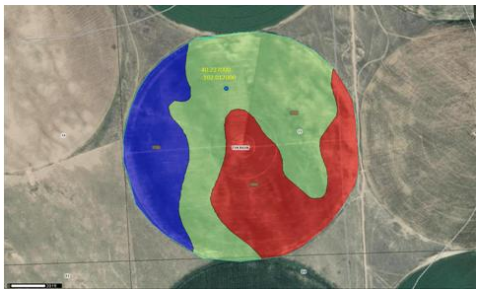
38 Rotations made in this season. Total application was 21.36".
The average application/rotation was .56 inches/Acre.

6-13-12: First irrigation event.
6-25-12: First 36" root activity.
6-23-12 - 7- 03 -12: Excellent root activity through all profile layers!! (Figure 1)
7-03-12: Beginning of 2 fast rotations that caused the 36" root zone to become inactive.
7-08-12: This Irrigation event caused the deep profile to shut down. The 20" root zone became active after 24hr and the 36" zone became active nearly 20 hrs later. A little too much water this go around.
7-11-12: All root zones stayed active until we lost readings on July 30th.
Period between 7-8 and 7-31 showed the most root activity in all areas.

Recommendations for 2013:
All in all a great job of irrigating.
Map the field as this appears to still be a light soiled field so recommendation remains the same as the NE field.
Unless I am missing something I believe this was a great use of our resources and nutrients.

Dundy1 Capacitance Summary Report

Dundy1 SW ¼ 13-3-42



Soil Type

Valent Sand

Water Holding Capacity

Inches	Soils Survey Map	Soil Test Lab
0-12"	.79"	.39"
0-24"	1.39"	.75"
0-36"	2.57"	1.20"
0-60"	3.75"	1.96"

*The soil probe was placed in the green soil type

		Consumptive crop water use, flow meter readings and power company caculations											
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/25/2012	4.20	0.25	V-2	0.3			5/28/2012	74.36	1.21
Dundy 1	Corn	132.8	6/27/2012	12.40	0.50	V-8	3.67			6/28/2012	366.67	5.95
C-1			7/20/2012	18.30	2.22	V-12	8.52	7/20/2012	10.08	7/30/2012	984.62	15.98
SW 1/4 13-3-42			8/27/2012	26.90	2.32	R-1	20.23			8/30/2012	1333.34	21.64
								10/10/2012	21.42	9/28/2012	1358.98	22.05

Dundy1

SW ¼ 13-3-42

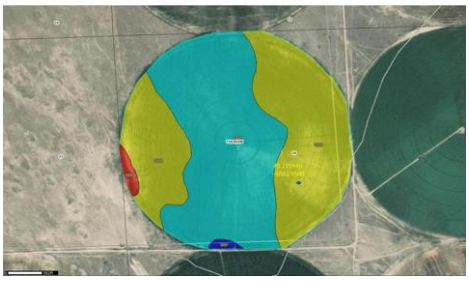
An overall sporadic irrigation pattern appears here-not sure if this was intentional or not. A slight increase and gradual decrease of water at the lower sensor depths could indicate potential leaching of nutrients (overall seasonal increase). The majority of the root activity seems to have taken place at or above the 16" soil depth which is concerning for utilization of all roots by the crop during stress periods.

According to the flow meter 21.42 inches of water were applied during the growing season and 33 rounds were made by the pivot for an average application of .65 inches/circle

Soil Type

Dundy1

NW ¼-24-3-42



Valent Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil Test Lab
0-12”	.67”	N/A
0-24”	1.54”	
0-36”	2.44”	
0-60”	3.62”	

* No soil tests were taken on this field.

		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/25/2012	4.20	0.25	V-4	0.3			5/29/2012	95.83	0.91
Dundy 1b	Corn	129.0	6/27/2012	12.40	0.50	V-8	3.67	6/7/2012	1.82	6/28/2012	561.05	5.35
C-2			7/20/2012	18.30	2.22	Silking	8.52	7/20/2012	12.46	7/30/2012	1226.27	11.69
NW 1/4 24-3-42			8/1/2012	26.90	2.32	R-1	20.23	8/25/2012	20.89	8/29/2012	1648.01	15.71
								10/10/2012	21.29	9/28/2012	1687.14	16.09

Dundy1

NW ¼ 24-3-42

This pivot has 572 GPM well. It is clear from the water availability in the soil profile the demand for water by the crop was exceeding the ability of the well to keep up. The downward trend line from each pivot revolution it was not keeping up because of this deficiency. Fortunately a rain of 1 inch occurred on July 7th to help and another .30 inch fell on July 12th. Later in the season the available water supply to the corn was below the refill mark.

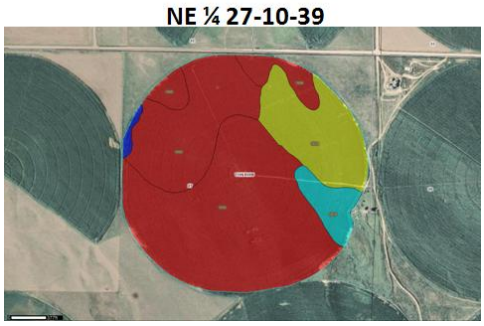
The second graph shows the roots did not penetrate to the 40" depth.

The pivot made 28 revolutions and applied a total of 21.29 inches for an average application of .76/rotation.

Perkins1 Capacitance Summary Report

Perkins1

NE ¼ 27-10-39



Soil Type

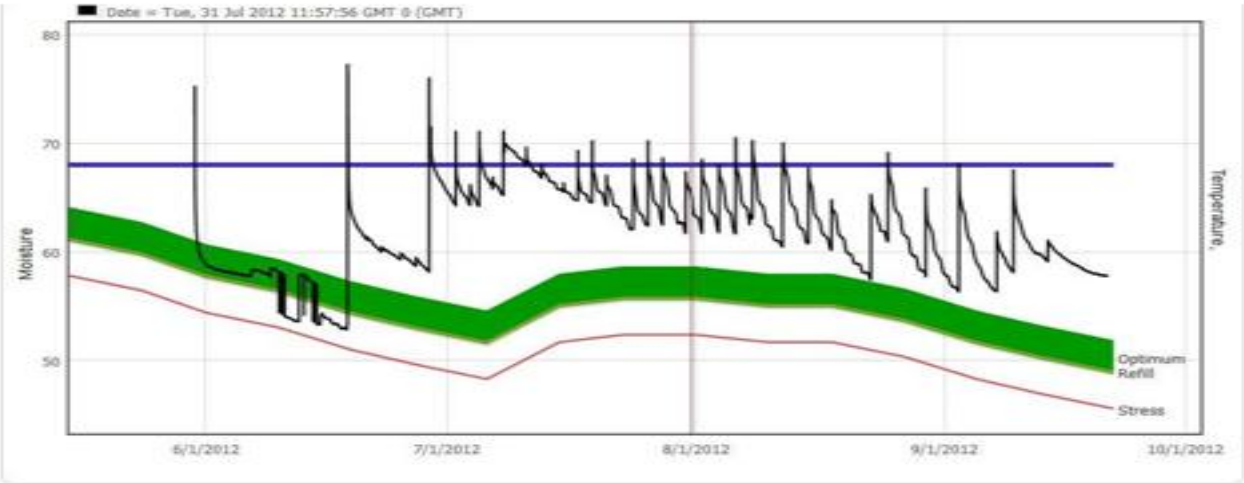
Valent Loamy Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	.93"	.99"
0-24"	1.61"	1.99"
0-36"	2.99"	2.84"
0-60"	4.37"	6.18"

* The red area is where the probe was installed.

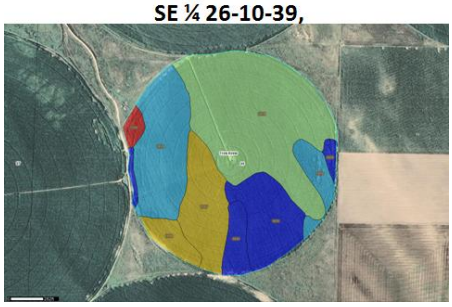
Perkins1
NE 27-10-39



		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/18/2012	2.70	0.60	V-2	0.27			5/31/2012	35.29	0.43
Perkins 1	Corn	127.5	6/26/2012	9.30	0.60	7 Col	1.86	6/26/2012	3.94	6/30/2012	395.65	4.80
NE 27			7/24/2012	16.10	3.50	V-14	6.37	7/26/2012	9.15	7/31/2012	872.76	10.58
NE 1/4 27-10-39			8/27/2012	22.70	4.07	F Dent	13.18	8/31/2012	15.30	8/31/2012	1389.50	16.85
			9/21/2012	27.80	4.22	F Mat	15.73	11/7/2012	17.75	9/11/2012	1565.35	18.99

The soil probe indicated the pivot should have been started after June 1 rather than around the 15th.Once irrigations started the available water was always above the refill mark. The field received .63 rain on the 4th of July and 2.30 on the 8th.
The pivot made 24 revolutions and applied a total of 17.75 inches for an average application of.73”/revolution.

Perkins1
SE ¼ 26-10-39,



Soil Type
Santana Very Fine Loam

Inches	Soil Survey Map	Soil Testing Lab
0-12”	1.76”	.73”
0-24”	3.59”	1.29”
0-36”	6.44”	1.91”
0-60”	9.06”	3.40”

* The probe was placed in the green area.

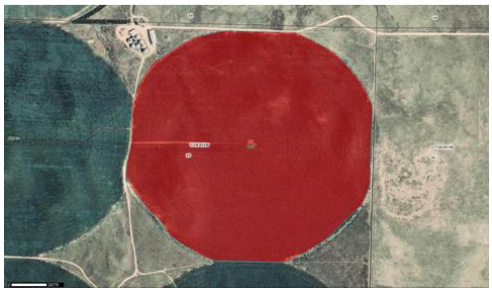
Perkins1
SW 26-10-39

		Consumptive crop water use, flow meter readings and power company caculations											
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/18/2012	2.70	0.60	V-2	0.27			5/30/2012	28.09	0.41
Perkins 1b	Corn	64.5	6/26/2012	9.30	0.60	10-Col	1.86	6/26/2012	4.43	6/30/2012	388.30	5.65
SW 26			7/24/2012	16.10	3.50	V-14	6.37	7/24/2012	10.85	7/31/2012	804.44	11.71
SW 1/4 26-10-39			8/27/2012	22.70	4.07	F Dent	13.18	8/31/2012	20.03	8/31/2012	1338.90	19.49
			9/21/2012	27.80	4.22	F Mat	15.73	11/7/2012	21.75	9/11/2012	1353.15	19.68

The probe was reinstalled after June 1 because of a placement error. This is a small circle of 64.5 Acres with a 425 GPM well and it doesn't take long to make a round. The corn made 220 bu/A and the field never was short of water during the growing season.
The pivot made 24 rounds and had a 2.30" on July 8th. 21.75" were applied during the season with an average application rate of .90"/rotation.

Lincoln1 Capacitance Summary Report

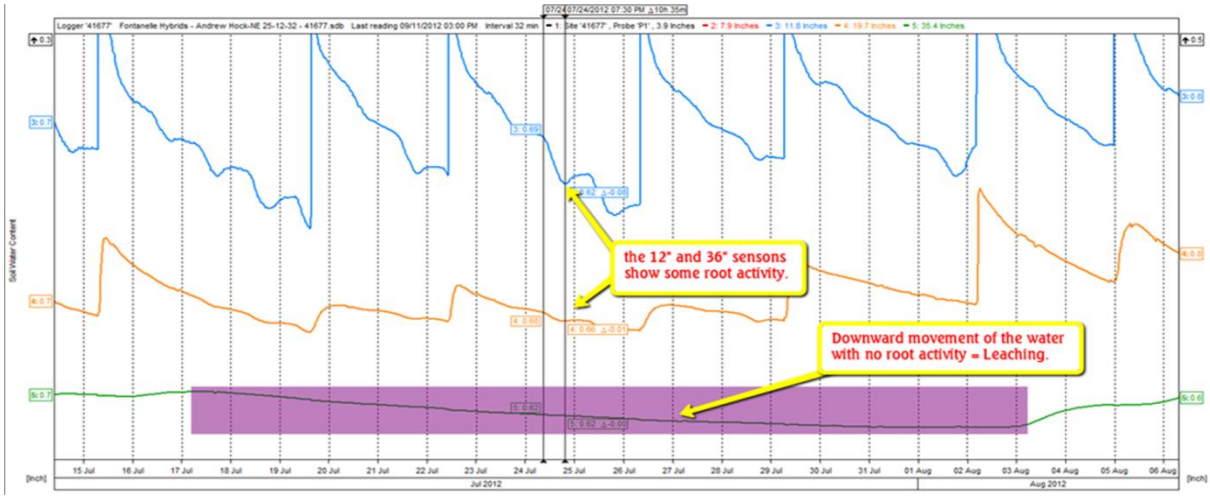
Lincoln1
NE 1/4 25 12-32

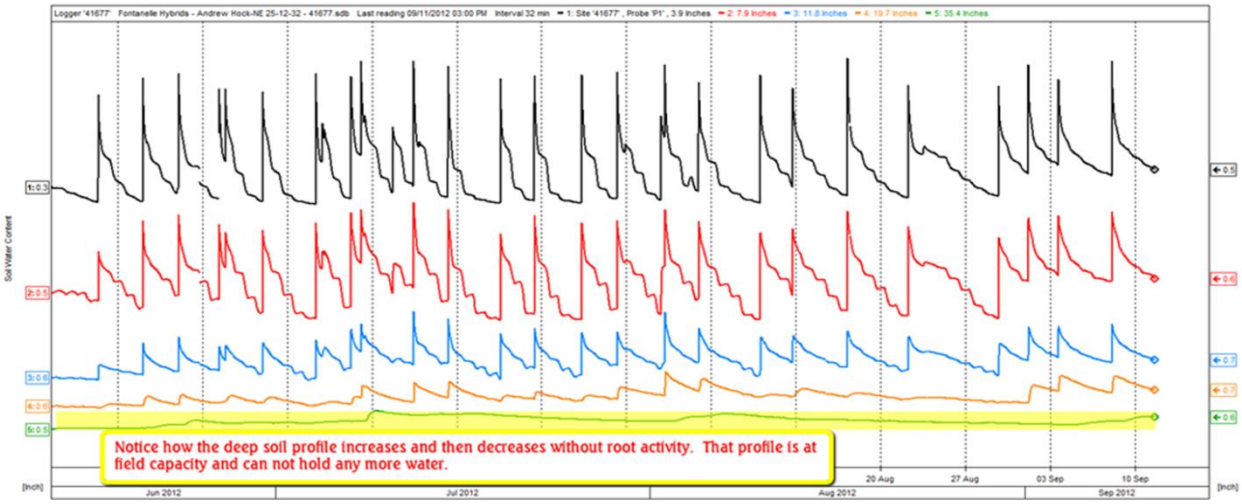


Soil Type
Valent Sand
Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	.74"	No tests
0-24"	1.43"	
0-36"	2.81"	
0-60"	4.31	

* The probe was placed in the read area.





		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter reports		Power Companies		
A	*B*	*C*	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/29/2012	4.90	0.70	V-2	0.21			5/31/2012	191.48	3.19
Lincoln0	Corn	134.4	6/25/2012	12.50	0.70	V-10	3.16			6/29/2012	603.75	10.05
25D			7/23/2012	20.70	1.95	R-2	10.68			7/27/2012	1122.05	18.69
SE 1/4 25-12-32			8/27/2012	27.70	2.10	R-5	18.38			8/31/2012	1644.23	27.38
			9/4/2012	30.50	2.10	R-5	21.07			9/7/2012	1812.17	30.18

Lincoln1
NE 25-12-32

26 Irrigation Events since the placement of the Probe. A total of 29.92 inches were applied/Acre. The average application rate was 1.15 inches/rotation.

6-16-12: First Irrigation event. At this point the subsoil was at field capacity.

7-08-12: First Irrigation event to raise the 36" soil moisture level. However the profile immediately drained out because it was at field capacity.

7-22-12: This Irrigation event began about an hour after the subsoil root system became active. This is an example of how the plant was using the deep soil profile yet when irrigation happened it became inactive in the deep soil. (Figures 1, 2 and 3 show examples of this procedure.)

8-27-12: In Figure 3 you will notice at this date the pivot had been shut off for quite a long period of time (about 7 days). During this time the plants were able to take up water and nutrients from the lower profile.

9-08-12: The last irrigation event.

Recommendations for 2013:

- Map the field. This field is very light soil according to the probe numbers and the depth and speed of water penetration. Knowing that the soil is in the field's majority soil water holding capacity soil will be critical for irrigation scheduling and maximum yield potential.
- Before pre-watering I would probe this field. According to the probe the profile was ok for moisture at the time the probe was removed.
- Consider VRI. In these light soils the time and application depth of irrigation is critical. Changes of only .10" per rotation in specific areas of the field would be huge at the end of the season.
- Use a triscan probe. I am assuming that this field is fertigated. A triscan probe will be critical to watch the movement of nitrogen through the profile.

Lincoln 1

SE ¼ 25-12-32

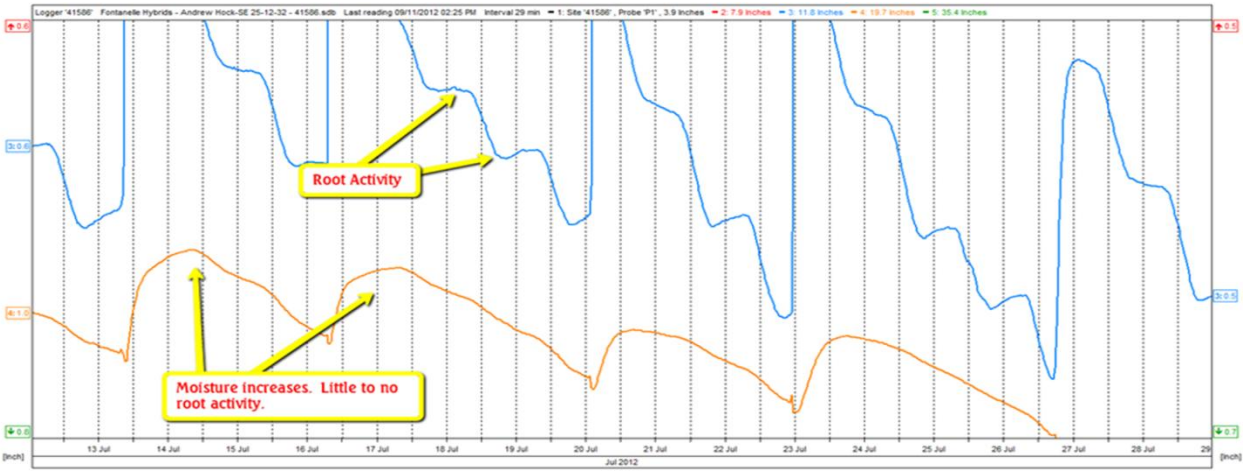
Soil Type

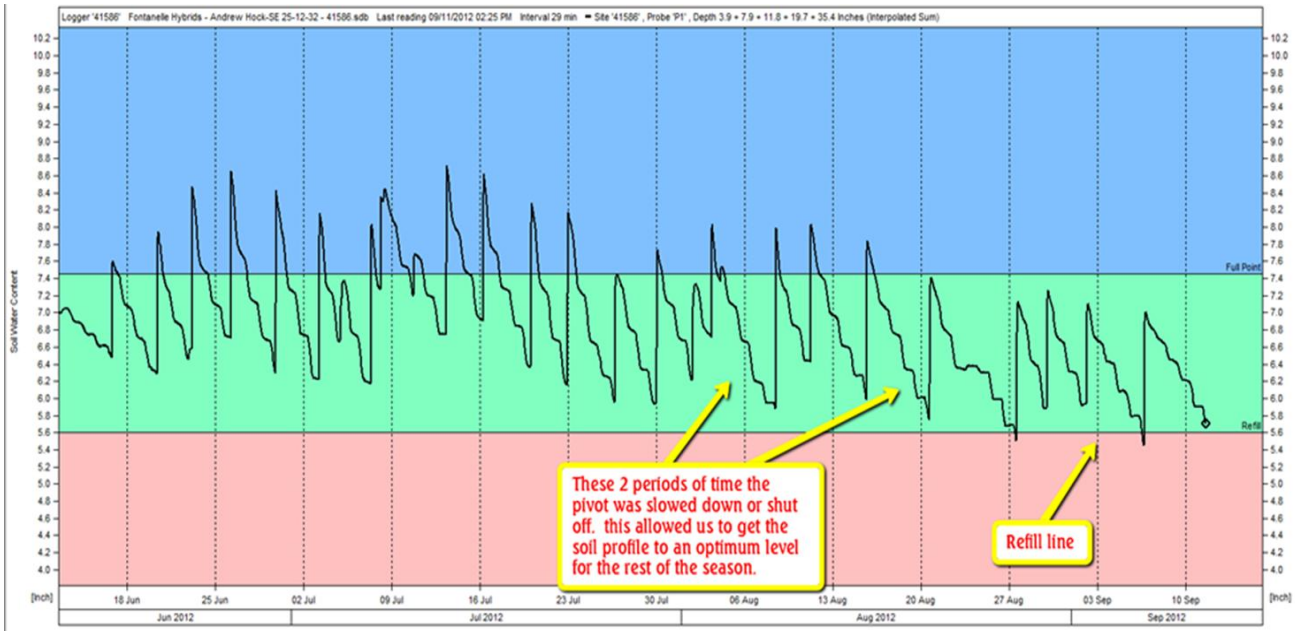
Valent Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	.74"	No Tests
0-24"	1.43"	
0-36"	2.81"	
0-60"	4.31"	

* Probe was placed in the red area





			Consumptive crop water use, flow meter readings and power company caculations									
			Grower will provide				UNL	Flow meter reports		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/29/2012	4.90	0.70	V-2	0.21			5/31/2012	153.84	2.70
Lincoln0	Corn	132	6/25/2012	12.50	0.70	V-10	3.16			6/30/2012	557.90	9.81
25A			7/23/2012	20.70	1.95	V-16	10.68			7/27/2012	1045.59	18.38
NE 1/4 25-12-32			8/27/2012	27.70	2.10	R-5	18.38			8/31/2012	1551.18	27.26
			9/4/2012	30.50	2.10	R-5	21.07			9/14/2012	1702.24	29.92

Lincoln1
SE 25-12-32

27 Irrigation Events since the placement of the Probe. A total of 30.18 inches were applied/Acre. The average application was 1.11 inches/rotation.
6-16-12: First Irrigation event. At this point the subsoil was at field capacity.
8-20-12: In Figure 3 you will notice at this date the pivot had been shut off for quite a long period of time (about 7 days). During this time the plants were able to take up water and nutrients from the lower profile. Roots in the 20" profile became active. There was no root activity in the 36" profile all season.
9-06-12: The last irrigation event.

Recommendations for 2013:

- Map the field. This field is very light soil according to the probe numbers and the depth and speed of water penetration. Knowing that the soil is in the field's majority soil water holding capacity soil will be critical for irrigation scheduling and maximum yield potential.
- Before pre-watering I would probe this field. According to the probe the profile was ok for moisture at the time the probe was removed.
- Consider VRI. In these light soils the time and application depth of irrigation is critical. Changes of only .10" per rotation in specific areas of the field would be huge at the end of the season.
- Use a triscan probe. I am assuming that this field is fertigated. A triscan probe will be critical to watch the movement of nitrogen through the profile.

Scottsbluff10 Capacitance and Ceramic probe summary report

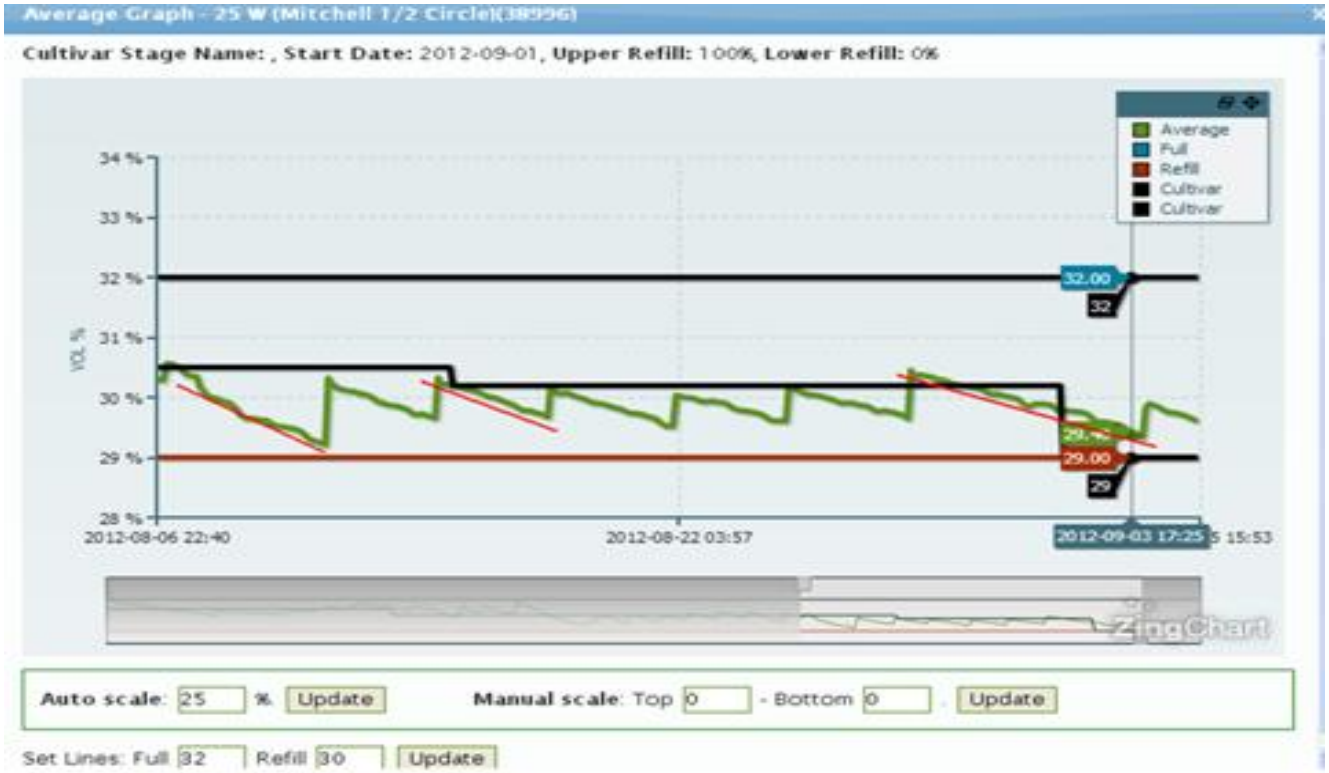
Scottsbluff10
W ½ 25-23-56

Soil Type
Alice Fine Sandy Loam
Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	**1.38"**	.80"
0-24"	**1.69"**	2.02"
0-36"	**5.38"**	3.55"
0-60"	**10.50"**	6.99"

* The probes were placed in the blue area.

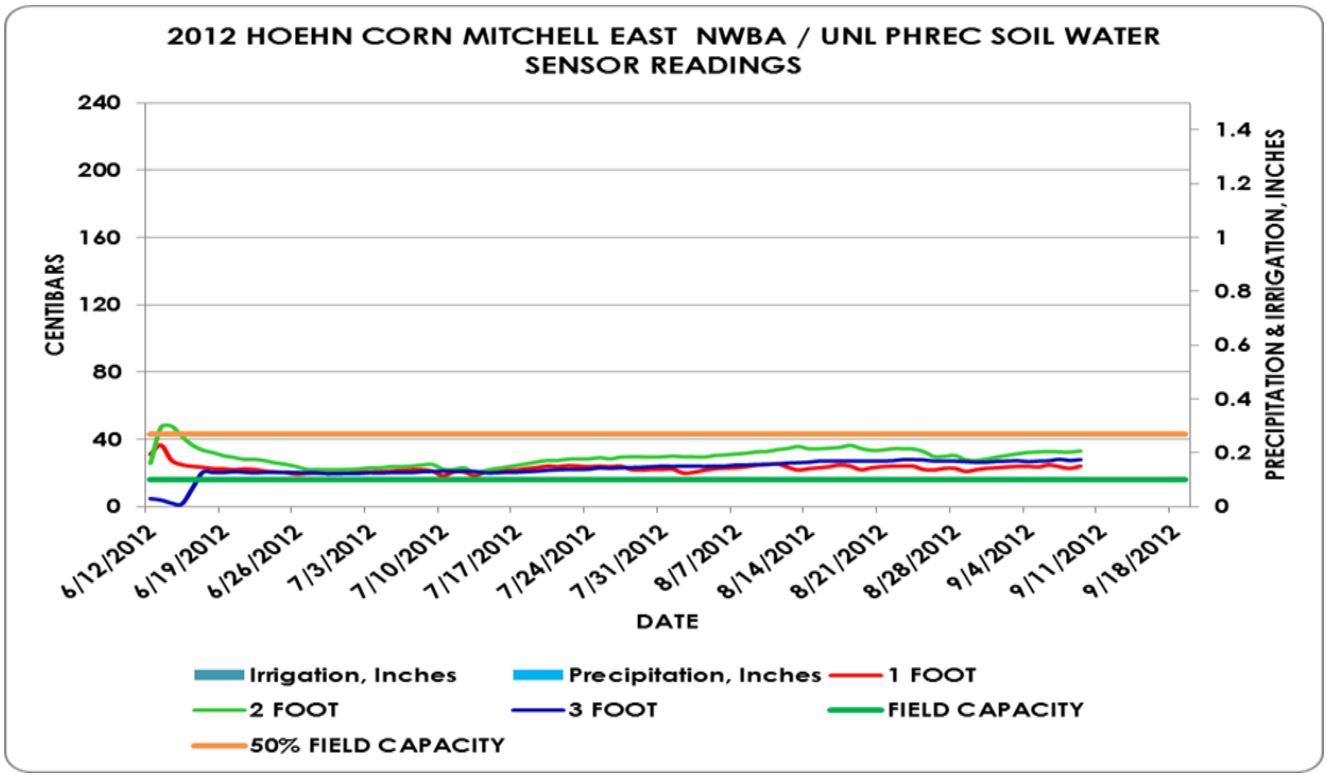
Driest point of season on August 11th
Strong water use without indication of stress throughout critical reproductive stage.



Slope of moisture removal indicate uniform water use.

Lowest moisture levels on top 2 sensors

With lower sensors showing available moisture indicate adequate moisture throughout the season



		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptiv Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/25/2012	6.00	1.20	V-3	0.63			5/31/2012	365.81	4.09
Scottsbluff1	Corn	227.5	6/28/2012	13.50	2.60	V-8	4.53	6/28/2012	3.12	6/30/2012	786.04	8.78
Mitchell East			7/26/2012	22.00	3.75	V-14	10.82	7/26/2012	10.82	7/31/2012	1368.09	15.28
W 1/2 25-23-56			8/23/2012	31.40	3.75	R-3	21.56	8/23/2012	15.89	8/31/2012	2034.96	22.73
										9/14/2012	2256.31	25.20

The above graph shows how ceramic probes read and post the data. The readings from these soil moisture sensors indicate that adequate soil moisture levels were maintained throughout the growing season at all sensor depths, between field capacity and 50% field capacity levels. Near the ends of the growing season, the producer could have cut back on his irrigation applications and utilized the soil water left in the soil profile.

The pivot applied 25.30 inches of water/Acre and made 19 rotations for an average application rate of 1.33 inches per revolution/Acre. Last watering was on Sep 8th.

Scottsbluff10

NE ¼ 26-23-56

Soil Type

Tripp Fine Sandy Loam

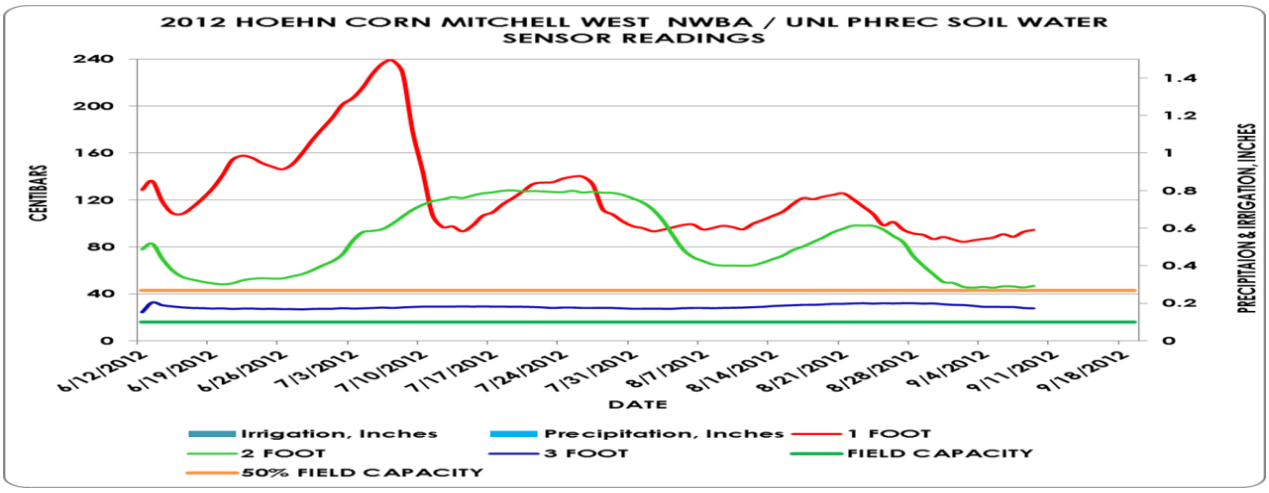
Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	**1.67”**	.89”
0-24”	**3.41”**	2.17”
0-36”	**6.97”**	4.66”
0-60”	**10.50”**	9.09”

Maximum effective depth of 32" reached July 7th

Driest point in season on July 6, 2012

Irrigation application exceeds water use from August 15th onward



		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptiv Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/25/2012	6.00	1.20	V-3	0.63			5/31/2012	157.06	1.82
Scottsbluff1	Corn	123.7	6/28/2012	13.50	2.60	10-Col	4.53	6/28/2012	2.02	6/30/2012	383.97	4.46
Mitchell West			7/26/2012	22.00	3.75	R-1	11.91	7/19/2012	6.09	7/31/2012	938.98	10.90
NE 1/4 26-23-56			8/23/2012	31.40	3.75	R-4	21.02	8/23/2012	22.66	8/31/2012	1480.10	17.19
										9/11/2012	1722.18	20.00

The individual sensor graph (Capacitance) shows quite a bit of deeper profile moisture (32” & 40”) available that was never used—these sensor values are considerably higher than the shallower sensors all season. Again, a slight increase and gradual decrease of water at these depths which may indicate potential leaching of nutrients. Lastly, the majority of the root activity seems to have taken place at or above the 16” soil depth which is concerning—perhaps looking at a hard pan in this profile. There’s just not much slope of daily stepping at the 24” sensor or below.

The readings from these soil water sensors (ceramic) indicate that inadequate soil moisture levels were below the 50% Field Capacity in the 1-foot sensor level and 2-foot sensor level most of the growing season. The producer had

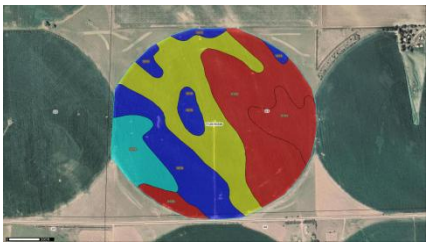
pump well trouble near the end of June which is indicated by the large spike in crop water use from the 1-foot sensor level, until irrigation was resumed about July 6th. Adequate soil moisture was maintained at the3-foot sensor level throughout the season.

A total of 22.66 inches of water/Acre was applied during the growing season. .45" of rain fell on July 7th and another .70" was received on the 11th for a total in season rainfall of 3.75 inches. The pivot made 20 revolutions after the sensors were installed for an average application of 1.13 inches/rotation.

Perkins3 Capacitance probe summary report

Perkins3

SW ¼ 23-12-36



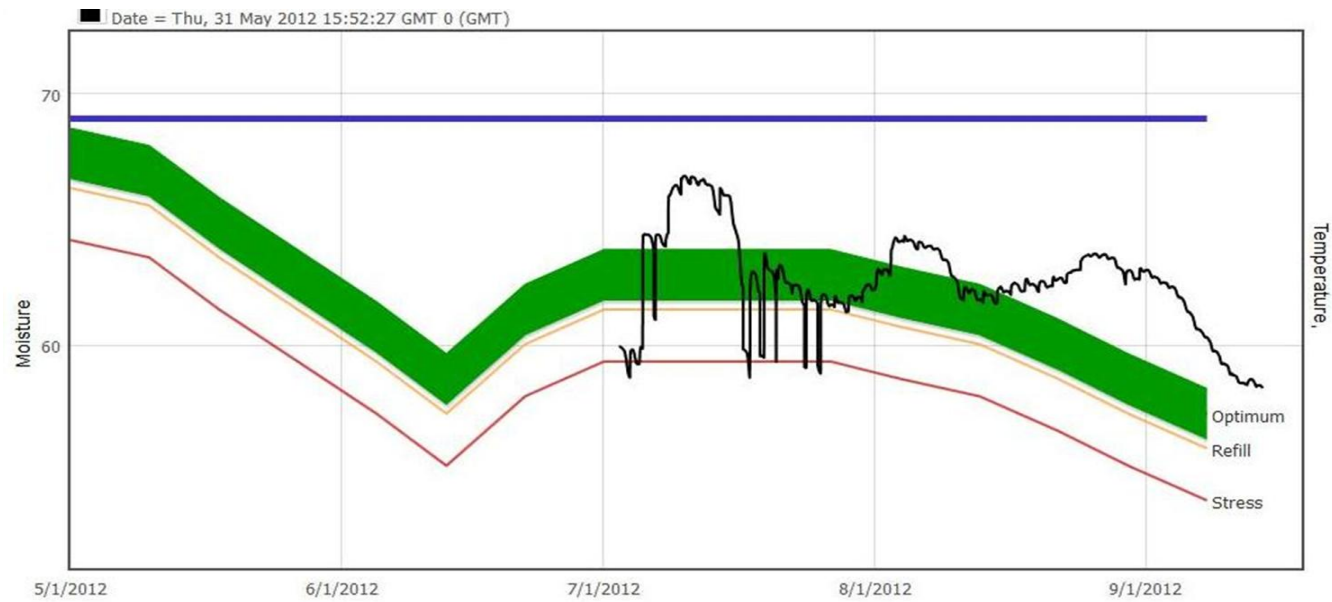
Soil Type

Sarben Loamy Very Fine Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	**1.32"**	.60"
0-24"	**1.79"**	1.10"
0-36"	**5.72"**	1.58"

* The probe was placed in the yellow area.

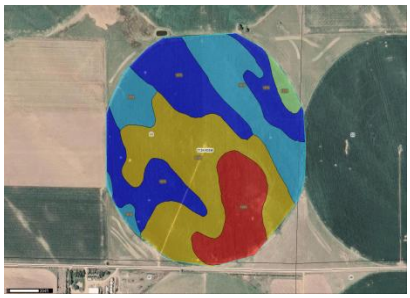


		Consumptive crop water use, flow meter readings and power company caculations											
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/31/2012	2.65	1.06	V-2	0.24			5/31/2012	77.87	1.07
Perkins 3	Corn	133.4	6/27/2012	11.75	1.06	8 Col	3.13			6/30/2012	292.51	4.00
Gillster W			7/30/2012	23.75	2.40	Milk	16.34	7/30/2012	12.37	7/31/2012	899.27	12.30
SW 1/4 23-12-36										8/31/2012	1517.50	20.76
								9/13/2012	21.60	9/13/2012	1547.99	21.18

The probe was installed on the 27th of June so the early irrigation is not recorded by the probe sensors and the crop was close to a stress situation. .32” of rain fell on the 5th of July and then another .72” fell on July 8th. A total of 2.70 inches were received during the growing season starting on May 19th when the ETGage was installed. At least 20 pivot rotations were made by the pivot for a total application of 22.73 inches/Acre or an average of 1.14 inches/revolution

Perkins3

SE ¼ 22-12-36



Soil Type

Sarben Loamy Very Fine Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil testing Lab
0-12”	1.32”	.60”
0-24”	2.79”	1.10”
0-36”	5.72”	1.58”
0-60”	8.67”	2.50”

* Probe installed in the yellow/brown area.

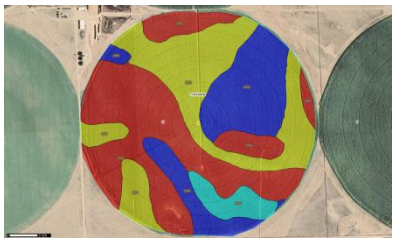
		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/21/2012	2.65	1.06	V-2	0.24			5/11/2012	47.06	0.62
Perkins 3b	Corn	129.2	6/27/2012	11.75	1.06	8 Col	3.13			6/30/2012	278.42	3.69
Gillster E			7/30/2012	23.75	2.40	Milk	16.34	7/30/2012	13.47	7/31/2012	966.69	12.81
SE 1/4 22-12-36										8/31/2012	1570.33	20.82
								9/13/2012	22.73	9/7/2012	1605.33	21.28

The probe was reinstalled because of location problems.
A total of 22.73 inches were applied during the growing season with a rainfall occurring on the 3rd of July and the 8th for a total of 2.40 inches for the season. The last irrigation was on Sep 7, 2012.

Morrill2 & 3 Capacitance Summary Report.

Morrill2

SW ¼ 2-18-48



Soil Type

Valent Loamy Fine Sand

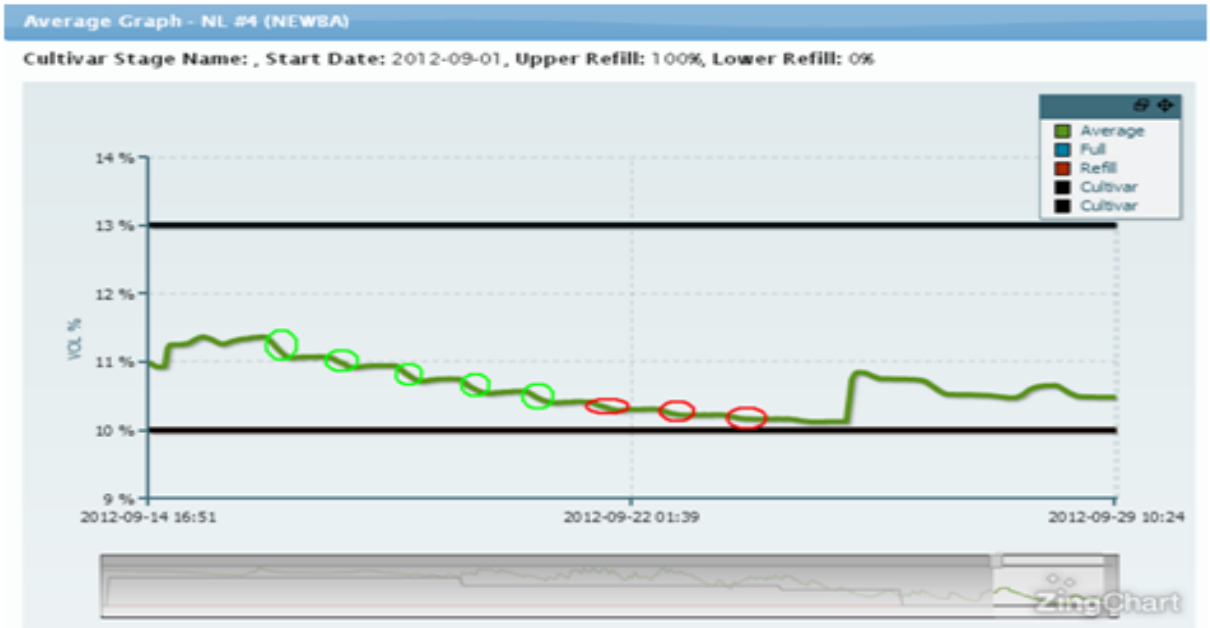
Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	.98”	.53”
0-24”	1.71”	1.13”
0-36”	2.50”	1.74”
0-60”	3.28”	3.16”

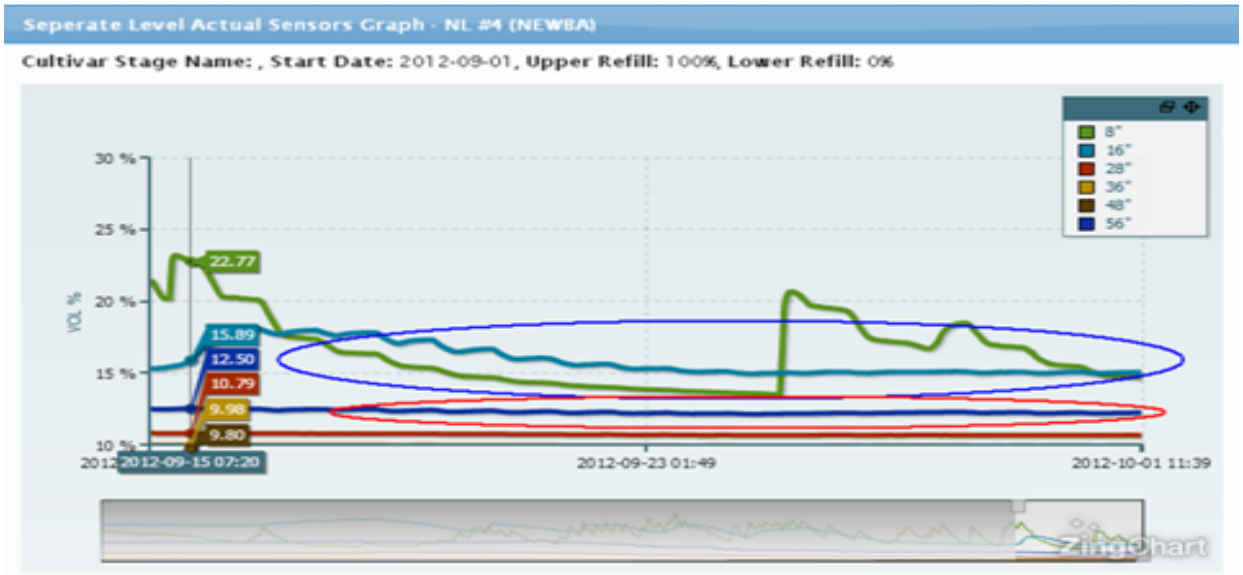
* The probe was placed in the yellow area.

Active Rooting depth reached 60" on July 11, maximum moisture depletion reached September 23rd.

Uniform extraction rates once full root zone is established



"Daily steps" start to flatten out as the plant struggles to extract moisture from the root zone reservior.



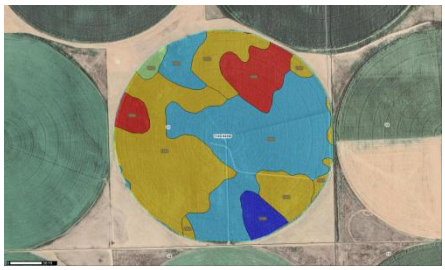
Plant is supported by irrigation water in the top 24" while lower depth of root zone is essentially depleted of soil moisture

		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/30/2012	5.10	0.20	6-8 leaf	0.75	5/23/2012	0.82			
Morrill 2	Beets	126.3	6/27/2012	15.40	1.05	57%	3.10	6/27/2012	3.56	6/25/2012	218.23	2.86
NE 4			7/25/2012	25.80	1.60	90%	11.40	7/25/2012	10.05	7/30/2012	745.39	9.78
SE 1/4 2-18-49			8/29/2012	36.30	1.90	100%	19.64	8/29/2012	17.40	8/31/2012	1220.23	16.01
			9/26/2012	43.90	2.05	100%	27.60			9/30/2012	1487.46	19.52

The sensor levels on this probe show a considerably drier until reaching the 56" sensor level which then has decent soil moisture. The rooting activity and water utilization still takes place primarily in the upper 24" of the profile. The field received 2.05 inches of rain during the growing season and the crop received an additional 19.52 inches from irrigation. There were approximately 18 revolutions made by the pivot with an average application of 1.08 inches/rotation.

Morrill3

SE ¼ 11-18-49



Soil Type

Alice Fine Sandy Loam

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	.98"	.27"
0-24"	1.91"	.50"
0-36"	3.09"	1.05"
0-60"	4.27"	2.07"

* The probe was placed in the blue area.

Driest point of season occurred Aug 16th.

Maximum rooting depth reached July 10th. Lowest moisture level at depth reached September 23rd

Daily Stepping indicate good transpiration

Irrigations were keeping up plant use as both top sensors indicate higher moisture levels than earlier in the season. This shows more plant available moisture in rootzone.

Irrigations exceeded plant needs around August 20th as moisture levels on sensors 2 & 3 increased with the 4th sensor increased around August 30th

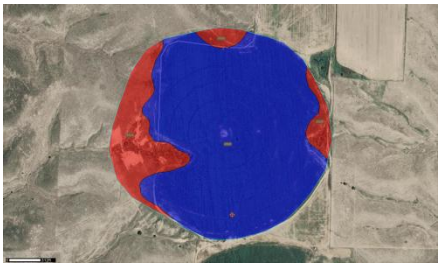
		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/30/2012	5.30	0.20	6-8 leaf	0.72	5/23/2012	0.82			
Morrill 3	Beets	128.4	6/27/2012	15.80	1.00	63%	3.46	6/27/2012	4.15	6/25/2012	209.61	2.34
NE 7			7/25/2012	25.60	1.75	100%	7.81	7/18/2012	7.81	7/30/2012	831.88	9.31
SE 1/4 11-18-49			8/27/2012	36.90	1.95	100%	20.11	8/27/2012	17.63	8/27/2012	1436.49	16.07
			9/26/2012	44.70	2.15	100%	28.15	9/26/2012	19.49	9/24/2012	1849.74	20.69

The probe show quite a difference in the overall seasonal shape when compared to Morrill2 and was much closer to the refill line during a period right after some of the highest anticipated daily water use for the crop in early to mid-August. Also of note are the recovery/increase of soil moisture in the 28" and 36" sensors in late June and Late August. The early season increase is likely from irrigation events supplying water in excess of rooting development at those depths and late season increase is likely due to declining crop water use with maintained irrigations.
The field received 2.05 inches of rain during the growing season and the crop received an additional 19.49 inches from irrigation. There were approximately 28 revolutions made by the pivot with an average application of .70 inches/rotation.

Frontier2 and 3 Capacitance Summary Report

Frontier2

SE ¼ 5-7-27



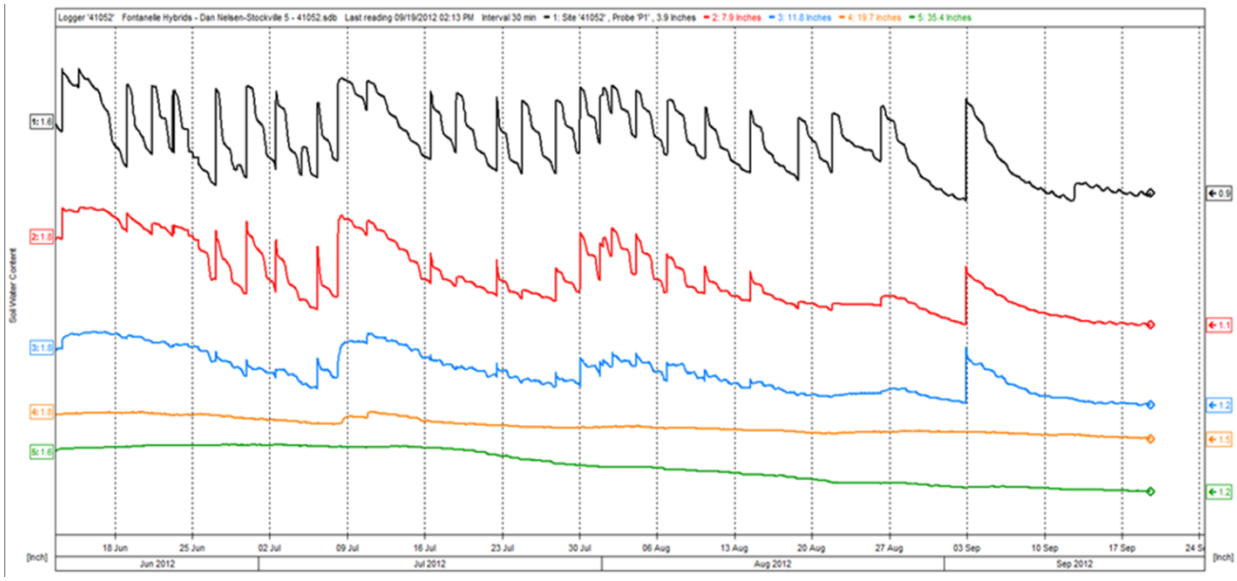
Soil Type

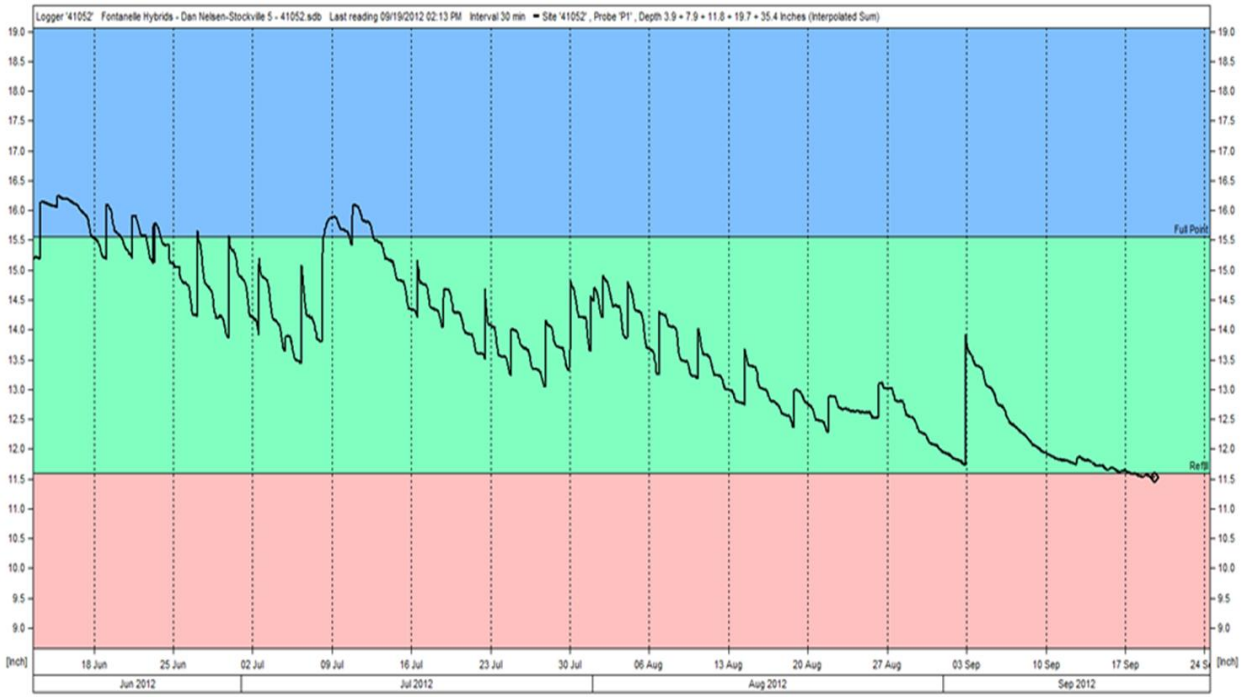
Holdrege Silt Loam

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12"	**2.26"**	1.49"
0-24"	**4.18"**	3.31"
0-36"	**8.23"**	5.74"
0-60"	**12.36"**	7.45"

* The probe was placed in the blue area.





		Consumptive crop water use, flow meter readings and power company caculations											
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/28/2012	6.20	0.25	?				5/30/2012	55.09	0.92
Frontier0	Corn	145.0	6/25/2012	12.96	0.25	V-12	3.97	6/25/2012	3.63	6/26/2012	265.73	4.45
Sec 5 Valley			7/23/2012	14.86	3.50	R-1	12.60	7/31/2012	13.60	7/31/2012	752.90	12.62
SE 1/4 5-7-27								8/27/2012	22.63	8/30/2012	1088.78	18.25
								9/17/2012	23.82	9/3/2012	1148.23	19.25

Frontier2
SE 5-7-27

6-13-12: Irrigations Began

7-06-12: Irrigation events that began a deep subsoil refill.

7-10-12: This irrigation event pushed water to the 20” sensors. This was the last irrigation event of the season to make it that deep.

7-15-12: Roots at the 36” Sensor became active.

7-29-12: Irrigation events pressed water deeper into the profile.

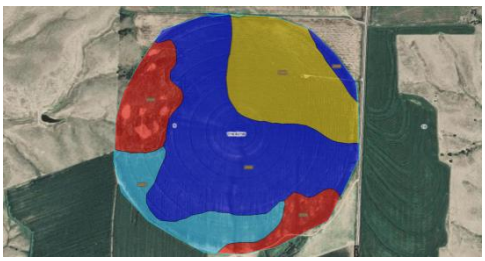
8-26-12: Deep root zone 36” begins to deplete of Plant Available Water (PAW). At the time of probe removal the 20” soil level is dry and yet the 36” soil moisture level is somewhat active although very depleted.

A total of 23.82 inches were applied during the irrigation season. 2.50 inches of rain fell on July 9th and another .75 inches on the 16th. Total in season rainfall was 3.50 inches. 22 rounds were made with an average application of 1.07 inches/revolution.

Recommendations for 2013:
Prepare for season with plans to pre-water if available.
If under allocated water contact CropMetrics for Water Optimization Refill Recommendations.
If possible after thaw check moisture content to at least 36” subsoil range.
If rain events do occur, map the field for optimized probe placement into the majority soil for maximum yield optimization.

Frontier3

SE ¼ 9-7-27



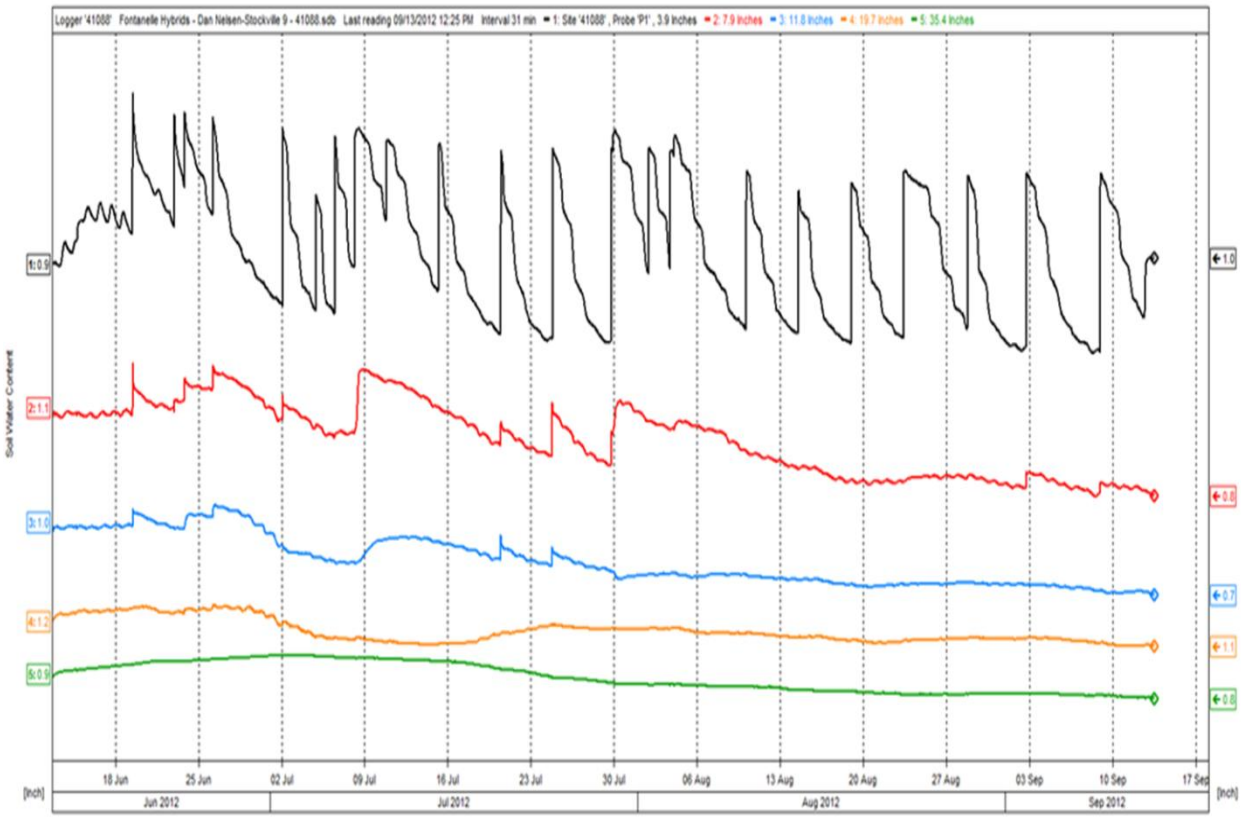
Soil Type

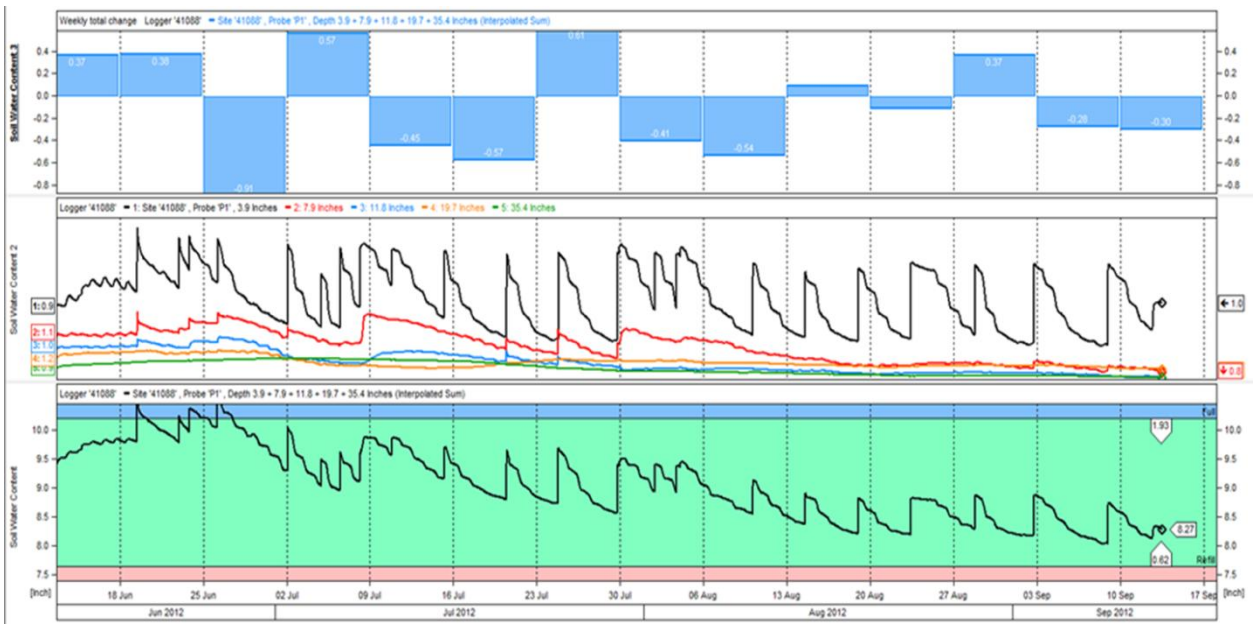
Holdrege Silt Loam

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	2.26”	1.47”
0-24”	4.18”	3.16”
0-36”	8.23”	5.17”
0-60”	12.36”	9.12”

* The probe was placed in the yellow area.





		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repor		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/28/2012	5.90	0.25					5/21/2012	23.52	0.28
Frontier1	Corn	213.7	6/25/2012	10.70	0.25	10-Col	2.38	6/27/2012	3.20	6/30/2012	351.16	4.18
Sec 9 (Reinke)			7/23/2012	12.10	3.55	Tassling	10.18	7/31/2012	9.22	7/31/2012	893.74	10.63
SE 1/4 9-7-27								8/27/2012	12.90	8/31/2012	1326.08	15.77
								9/17/2012	14.72	9/9/2012	1431.06	17.02

Frontier3
SE 9-7-27

6-26-12: First noticeable root activity.
7-04-12: First 36" root activity.
7-08-12: First irrigation event to reach the 20 inch level.
7-20-12: Next ten days worth of irrigation appeared to be slower rotations thus pushing water to deeper profiles. Great Job!!
7-29-12: This irrigation until the end of the season was unable to provide refill to the subsoil. 36" profile appears to be depleted.

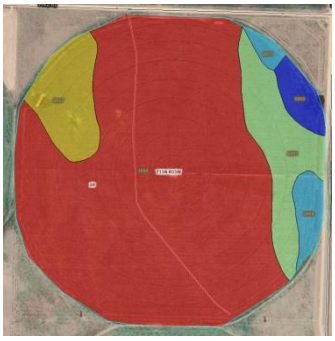
The field received 3.55 inches of rain during the growing season of which 2.50 inches came on July 9th and another .75 inch came on July 16th. The field received a total of 14.72 inches of irrigation for the season. The pivot made 20 revolutions for an average application of .74 inches/rotation.

Recommendations for 2013:
Prepare for season with plans to pre-water if available.
If under allocated water contact CropMetrics for Water Optimization Refill Recommendations.
If possible after thaw check moisture content to at least 36" subsoil range.

If rain events do occur, map the field for optimized probe placement into the majority soil for maximum yield optimization.
For the most part this was a Great Job of irrigating. May slow down pivot if possible without runoff.

Lincoln2 Capacitance Summary Report

Lincoln2
NE ¼ 28-13-33



Soil Type
Hersh Soil
Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	**1.67”**	1.12”
0-24”	**3.26”**	2.67”
0-36”	**6.41”**	4.47”
0-60”	**9.56”**	6.55”

* The probe was placed in the red area.

PH1 (33218)
Rooting depth reached 40” right around the 1st of July. From that point on moisture did not increase at the 40” but did start increasing at the 16” level around July 20th indicating irrigation began to exceed plant needs slightly and then around August 1st the plant needs diminished and total moisture seemed to level off through the balance of August.

- Plant needs seemed to be met with irrigation from Mid-July through August. Beginning the end of August the profile was mined of quite a bit of the remaining moisture.

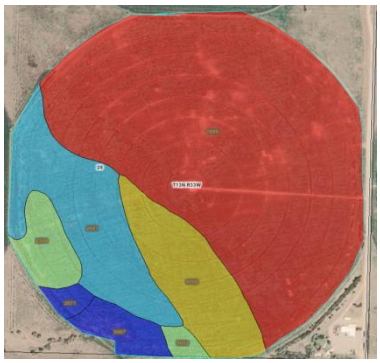
In both scenario's the season ended with a substantial room for off season moisture or one might consider doing some pre-watering in the spring to build up the reservoir.

		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repor		Power Companie		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/28/2012	1.90	0.49	V-2	0.19			5/29/2012	44.78	0.63
Lincoln 2	Corn	130	6/25/2012	10.20	0.97	V-8	2.72			6/29/2012	455.07	6.38
PH1			7/30/2012	18.8	1.85	V-14	10.34	7/3/2012	8.75	7/27/2012	1008.09	14.14
NE 1/4 28-13-33			8/27/2012	26.62	2.71	F Dent	17.92			8/31/2012	1601.71	22.46
			9/3/2012	28.23	2.71	B Layer	18.89	9/3/2012	27.70	9/7/2012	1607.91	22.55

The field received 2.71 inches of rain during the growing season. The pivot made 26 revolutions and applied 27.70 inches for an average application of 1.07 inches/revolution.

Lincoln 2

SE ¼ 28-13-33



Soil Type

Valent Sand

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	**.74”**	.28”
0-24”	**1.43”**	.60”
0-36”	**2.81”**	.94”
0-60”	**4.19”**	1.78”

* The probe was placed in the red area.

The two red circles are reference points to the same relative time frames for the separate sensor graph listed below.

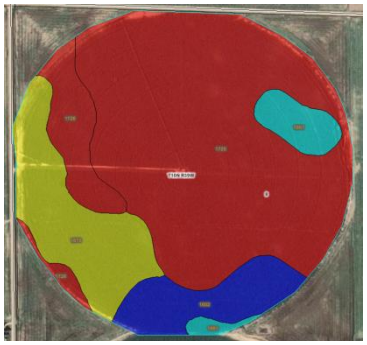
		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repo		Power Companie		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
Lincoln 2b	Corn	127.5	5/28/2012	1.90	0.49	V-2	0.13	#######	0.04	5/29/2012	43.68	0.61
PH2			6/25/2012	10.20	0.97	V-8	2.66			6/30/2012	528.92	7.42
SE 1/4 28-13-33			7/30/2012	18.80	1.85	V-14	10.28	7/3/2012	11.34	7/31/2012	1222.52	17.14
			8/27/2012	26.62	2.71	F Dent	17.86			8/30/2012	1754.90	24.61
			9/3/2012	28.23	2.71	B Layer	18.83	9/3/2012	25.72			

The field received 2.71 inches of rain during the growing season. The pivot applied 25.72 inches with 36 rotations for an average application of .71 inches/revolution.

Perkins2 Capacitance Summary Report

Perkins2

NW ¼ 8-10-39



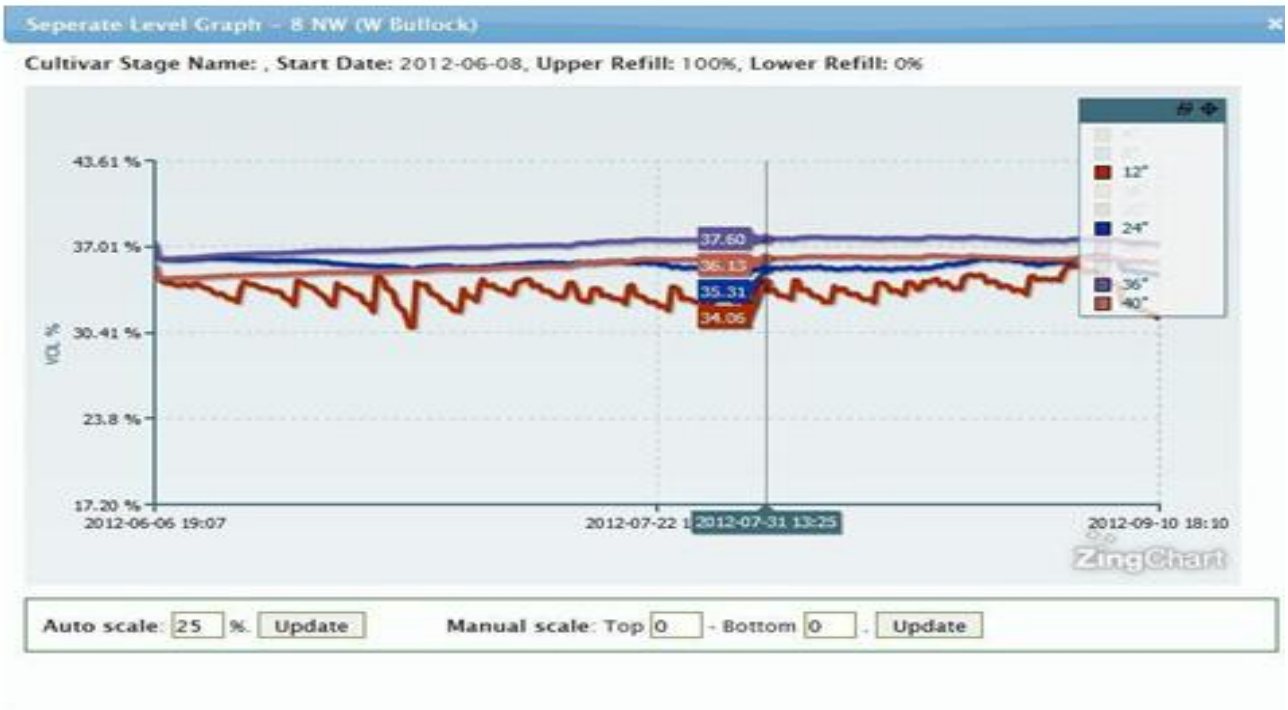
Soil Type

Rosebud Loam

Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	**1.99”**	1.83”
0-24”	**3.56”**	3.63”
0-36”	**5.12”**	5.45”
0-60”	**8.16”**	8.26”

* The probe was placed in the red area.

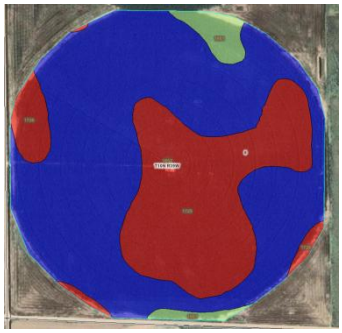


		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/29/2012	5.90	0.40	V-2	0.42					
Perkins 2	Corn	123.5	6/26/2012	15.20	0.40	8 Coll	2.15			6/30/2012	333.62	5.12
Bullock N			7/24/2012	24.90	2.40	V-12	8.05	7/10/2012	5.83	7/31/2012	877.60	13.46
NE 1/4 8-10-39			8/31/2012	36.40	2.40	F Dent	18.50	8/21/2012	14.86	8/31/2012	1496.91	22.96
								11/7/2012	19.39	9/7/2012	1580.50	24.24

The lower profile sensors are essentially wetter for the entirety of the season when compared to the shallower sensors—with the 32” sensor having the highest soil moisture level. This crop appeared to survive on the intake at soil depths above 24” and mainly above16”—there just isn’t much stepping in the 16’ sensor here either. This could be an excellent place to determine if a hardpan exists in this profile. An overall increase in soil moisture levels in the bottom 4 sensors throughout the season until the beginning of September would possibly indicate water pushed down through the profile and potential of leaching of some nutrients.
The field received 2.40 inches of rain of which 1.00” fell on July4th and another inch on Jul8th. The pivot applied 19.39 inches during the season and made 19 revolutions with an average application of 1.01inches/rotation.

Perkins2

SW ¼ 8-10-39



Soil Type

Kuma Silt Loam

Water Holding Capacity

Inches	**Soil Survey Map**	Soil Testing Lab
0-12”	**2.07”**	2.30
0-24”	**4.06”**	4.55”
0-36”	**8.01”**	6.14”
0-60”	**12.15”**	9.72”

* The probe was installed in the blue area.

		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter report		Power Companies		
A	*B*	*C*	D	E	F	*G*	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
			5/29/2012	5.90	0.40	V-2	0.42					
Perkins 2b	Corn	128.3	6/26/2012	15.20	0.40	8-Col	2.15			6/30/2012	372.10	4.81
Schmidt S			7/24/2012	24.90	2.40	V-12	8.05	7/10/2012	4.93	7/31/2012	921.11	11.90
SW 1/4 8-10-39			8/31/2012	36.40	2.40	F Dent	18.50			8/31/2012	1466.50	18.94
								11/7/2012	14.86	9/2/2012	1476.56	19.07

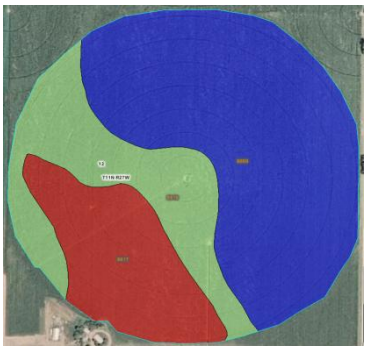
The flow meter reading of 14.86 inches on 11-7 is much lower than the power company report because late in the irrigation season the irrigation well started cascading and did not produce the amount of water it was designed for.

The field received 2.40 inches of rain of which 1.00” fell on July 4th and another inch on July 8th. The pivot and made 21 revolutions with an average application of .71 inches/rotation.

Lincoln3 Capacitance Summary Report.

Lincoln3

SE ¼ 12-11-27



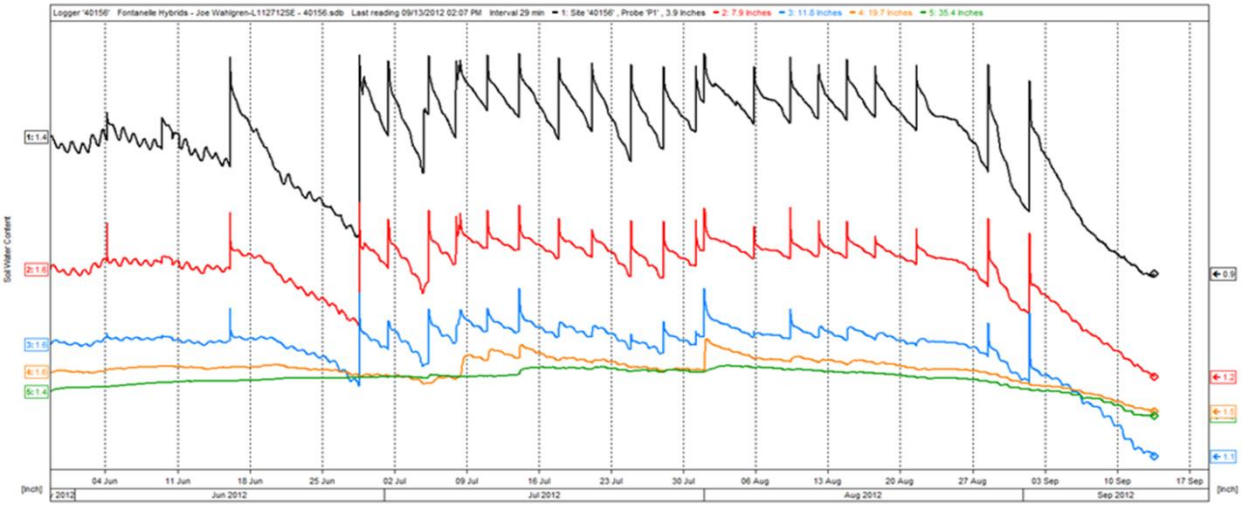
Soil Type

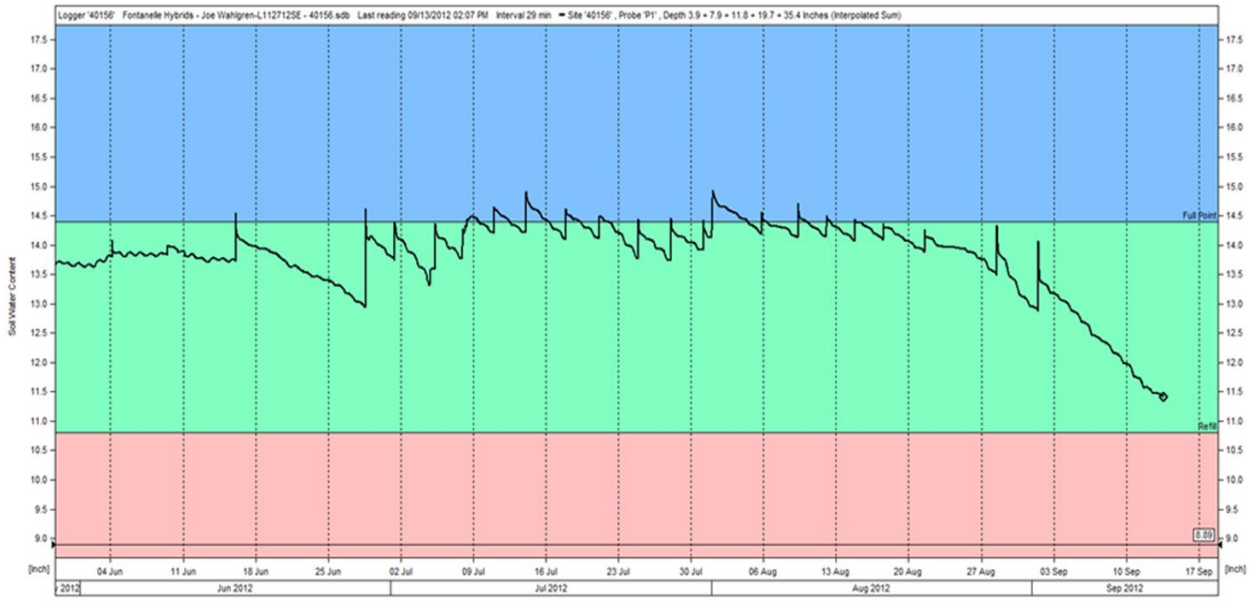
Hoard Silt Loam

Water Holding Capacity

Inches	**Soil Survey Map**	Soil Testing Lab
0-12”	**2.17”**	1.88”
0-24”	**4.33”**	3.81”
0-36”	**8.55”**	5.58”
0-60”	**12.49”**	9.29”

* The probe was placed in the blue area.





		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repo		Power Companies		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
Wahlgren			5/28/2012	5.70	1.05	VC	0.25			5/25/2012	103.34	1.37
Lincoln 3	Soybeans	123.5	6/25/2012	14.50	2.05	6-7 Tri	6.28			6/29/2012	275.84	3.65
Palmer S			7/23/2012	23.90	2.70	R-3	18.43			7/27/2012	810.83	10.74
SE 1/4 12-11-27			8/27/2012	30.80	3.90	R-6	25.39			8/24/2012	1295.11	17.15
			9/3/2012	32.90	3.90	R-7	25.81			9/7/2012	1414.16	18.72

Lincoln3
SE 12-11 27

6-28-12: Water usage was good at the 20” root zone. As water rotations continued the profile continued to fill.

7-05-12: As the profile continued to rise the root activity quit at the 20” root level.

7-14-12: Profile continued to fill until this time. Then pivot experienced a 4 day down time. This allowed the 20 and 36” root zones to become active.

7-28-12: 36” root activity stops due to increased water in the 20” root zone. The field is not at full saturation at this time so roots are still active.

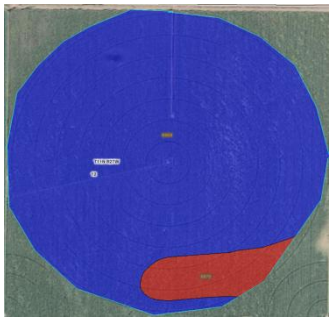
8-01-12: Irrigation events cause field to go into saturation for about 36-48 hours.

8-27-12: Entire root zone becomes active again as the soil falls back into field capacity level. 36” sensor shows activity for several days after water shut down at end of season. (Until Probe was removed).

The field received 3.90 inches of rain of which 1.00” fell on June 25th and another 1.20 inches on Aug 6th. The pivot applied 18.72 inches during the season and made 19 revolutions with an average application of .99 inches/rotation.

2012 Recommendations
Map Field with EC for exact probe placement.
Prepare field for VRI
Have field checked for preseason moisture and then pre-water accordingly.
With conditions being the same next year I would recommend eliminating at least 2 rotations.
This field according to the probe has good water holding capacity. After mapping the fields to determine majority soil type reset the probe in majority soil. I suspect this is an area that has a heavier soil content.

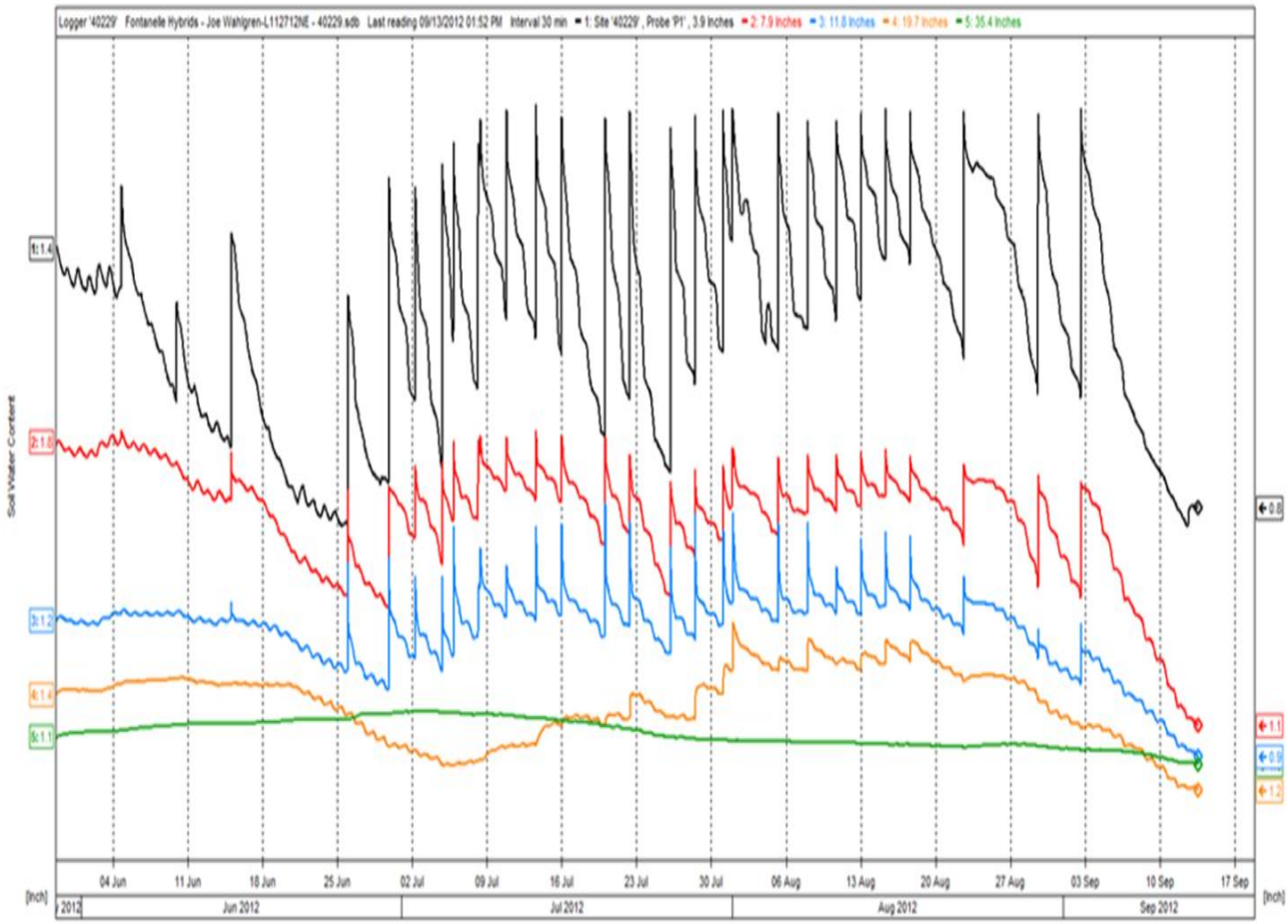
Lincoln3
NE ¼ 12-11-27

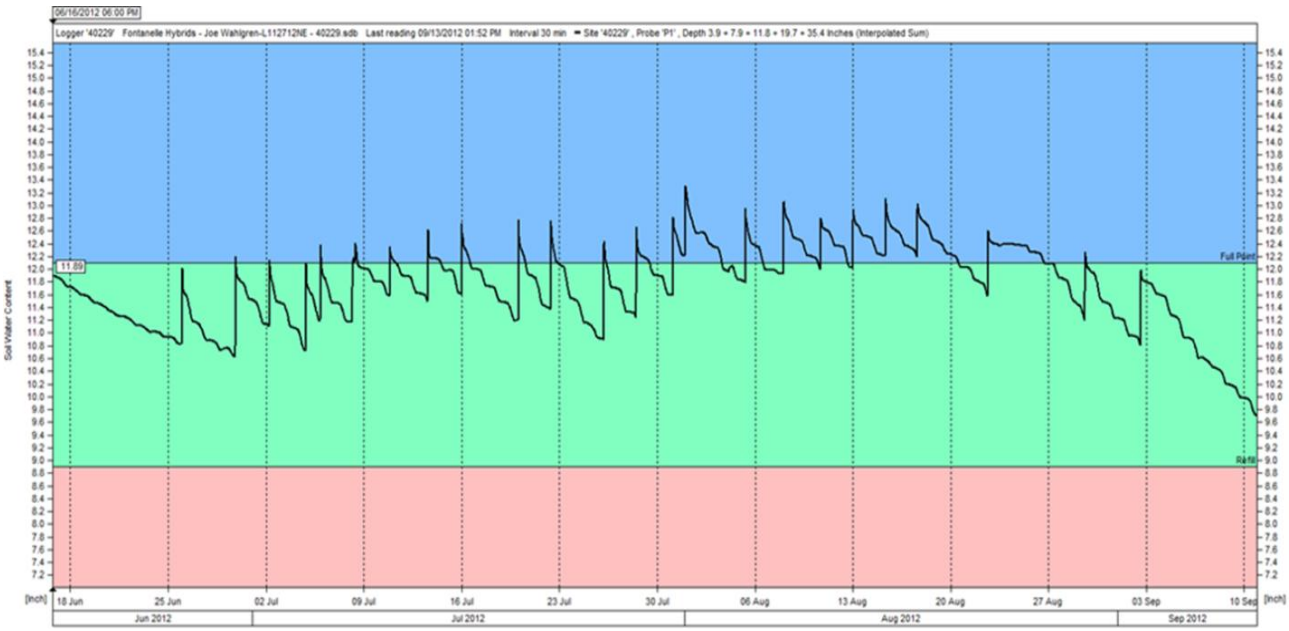


Soil Type
Hoard Silt Loam
Water Holding Capacity

Inches	Soil Survey Map	Soil Testing Lab
0-12”	2.17”	2.12”
0-24”	4.33”	4.07”
0-36”	8.55”	7.26”
0-60”	12.49”	10.19”

* The probe was placed in the blue area.





		Consumptive crop water use, flow meter readings and power company caculations										
			Grower will provide				UNL	Flow meter repo		Power Companies		
A	B	C	D	E	F	G	H		I	J	K	L
Cooperator	Crop	Acres in the Field	Date of Last Report	ET Accum To Date	Rainfall to date	Stage of Growth	Consumptive Crop use to date	Date of Last Report	Inches water applied	Date of Last Report	Hours Irrigated	Inches water applied
Wahlgren			5/28/2012	5.70	1.05	VC	0.25			5/25/2012	107.47	1.50
Lincoln 3b	Soybeans	118.4	6/25/2012	14.50	2.05	6-7 Tri	6.28			6/29/2012	256.89	3.58
Palmer N			7/23/2012	23.90	2.70	R-3	18.43			7/27/2012	776.53	10.81
NE 1/4 12-11-27			8/27/2012	30.80	3.90	R-6	25.39			8/24/2012	1227.25	17.09
			9/3/2012	32.90	3.90	R-7	25.81			9/7/2012	1334.91	18.59

Lincoln3
NE 12-11-27

6-20-12: Water usage was good at the 20” root zone. As Irrigation continued the profile continued to fill. Water draining to the 36” root zone but no root activity.

7-05-12: As the profile continued to rise the root activity quit at the 20” root level.

7-16-12: Profile continued to fill until this time. Then pivot experienced a 4 day down time. This allowed the 36” root zones to become active. 20” soil water content continued to rise.

7-31-12: 36” root activity stops due to increased water in the 20” root zone.

8-01-12: Irrigation events cause field to go into saturation for about 36-48 hours.

8-27-12: Entire root zone becomes active again as the soil falls back into field capacity level. 36” sensor shows activity for several days after water shut down at end of season. (Until Probe was removed).

The field received 3.90 inches of rain of which 1.00” fell on June 25th and another 1.20 inches on Aug 6th. The pivot applied 18.59 inches during the season and made 22 revolutions with an average application of .85 inches/rotation.

2012 Recommendations

Map Field with EC for exact probe placement.
Prepare field for VRI
Have field checked for preseason moisture and then pre-water accordingly.
With conditions being the same next year I would recommend eliminating at least 2 rotations.

Nitrate studies:

The cooperating growers indicated early in the discussions that they had reservations about the reliability of the capacitance probe calibrations and wanted more assurance as to their accuracy. A decision was made to take core samples next the probes to determine from soil lab tests the water holding capacity of the soil. Then that information was correlated with probe vendor settings. Since core samples were part of the plan it was easy to add nitrate testing to the project. By adding mid growing season and harvest sampling it was not hard to track nitrate movement in the soil. Included in the nitrate study were 19 out of 22 pivots. Each 3 sample set/pivot cost the participating grower an average of $281 or $562 for both pivots.

The results of the study are shown in the summary sheet showing nitrate movement and uptake. It was also assumed that at the end of the season the nitrates located in the 36 to 84” level were at risk because of off-season recharge and early spring precipitation and there was no active root system to take the nitrogen up. Winter wheat may be an exception to the assumption.

The value of nitrogen lost was calculated based on the total pounds of nitrogen identified by the soil tests.

Results from the nitrate studies:

There is not doubt that growers need to pay more attention to nitrogen management in the future. 2012 was a dry year and very little nitrogen moved out of the profile during the active growing season. Nitrate nitrogen moves in the soil with the wetting front of the water and can be used as a guide for better water management as they work together.

The graphs below show nitrates down to 3 lbs./A to a high of 96 lbs./A in the bottom 5 Ft at harvest time. Nitrogen fertilizer (32-0-0) was priced the same day as the calculations were made which was $420/Ton or $.656/lb. The lowest loss was $9.84/A to a high of 102.99/A. **The average loss was $33.10/A X 2615.7A = $86,588.85**. The other concern is the movement of nitrates into the aquifer affecting the water quality.

NEWBA Nitrate movement studies

17-Dec-12 Revised Dec 29-12

	NE 15-10-33 Lincoln0 129.1	SW 13-3-42 Dundy1 129.9	NE 27-10-39 Perkins1 127.5	W 25-23-56 Scottsbluff10 227.5	SE 22-12-36 Perkins3 133.4	SW 2-18-49 Morrill2 126.3	SE 5-7-27 Frontier0 145	NE 28-13-33 Lincoln2 130	NW 8-10-39 Perkins2 126.5	SE 12-11-27 Lincoln3 123.5	Field AVERAGES 1398.7
NRCS Soil Type	Valent Sand	Valent Sand	Valent L Sand	Trip F S Loam	Sarben LVF S	Valent L F S	Holdrege S L	Hersh Soil	Mace S L	Hoard S L	
Olsen Lab results	S on 5-29-12	No Sample`	S on 6-4-12	S on 6-4-12	S on 6-27-12	S on 6-7-12	S on 6-12-12	S on 6/11/2012	S on 6/6/2012	S on 5/29/2012	
Depth	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A
Water H Cap. 0-12"	135		114	79	39	103	71	88	135	113	97
Water H Cap. 13-24"	92		66	60	7	86	18	13	30	58	48
Water H Cap. 25-36"	96		50	69	22	109	6	48	53	92	61
Water H Cap. 37-60"	102		138	102	41	94	19	58	60	134	83
Water H Cap. 61-84"											
Average	425		368	310	109	392	114	207	278	397	289

Olsen Lab results	S on7-17-12		S on 7-14-12	S on 7-10-12	S on 7-27-12	S on 7-27-12	S on 7-17-12	7/18/2012	7/30/2012	7/17/2012	
Depth	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A
Water H Cap. 0-12"	44		135	77	29	72	44	40	40	40	58
Water H Cap. 13-24"	35		36	34	11	34	21	16	30	30	27
Water H Cap. 25-36"	39		31	58	11	16	21	13	15	15	24
Water H Cap. 37-60"	42		57	75	19	33	29	34	21	21	37
Water H Cap. 61-84"											
Average	160		259	244	70	155	115	103	106	106	146

Olsen Lab results	S on 10/19/2012		10/17/2012	10-11-12	10-17-12	10/11/2012	10-18-12	9/20/2012	10/19/2012	10-18-12	
Depth	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A
Water H Cap. 0-12"	20		49	13	18	9	41	16	16	31	24
Water H Cap. 13-24"	9		17	24	15	8	4	15	11	9	12
Water H Cap. 25-36"	12		21	66	4	5	4	7	14	9	16
Water H Cap. 37-60"	36		57	96	7	7	14	18	19	30	32
Water H Cap. 61-84"	32		58	61	6	11	9	19	20	22	26
Average	109		202	260	50	40	72	75	80	101	110
Nitrate at risk	68	$ -	115	157	13	18	23	37	39	52	52
Cost/A @ $.656/Lb	$ 44.61	$ -	$ 75.44	$ 102.99	$ 8.53	$ 11.81	$ 15.09	$ 24.27	$ 25.58	$ 34.11	$ 38.05
Cost/Field	$ 5,758.89	$ -	$ 9,618.60	$ 23,430.68	$ 1,137.64	$ 1,491.35	$ 2,187.76	$ 3,155.36	$ 3,236.38	$ 4,212.83	$ 53,217.74

	SW 15-10-33 Lincoln0b 135.4	SW 24-3-42 Dundy1b 132.8	SW 26-10-39 Perkin1b 64.5	NE 26-23-56 Scottsbluff10b 123.7	SW 23-12-36 Perkins3b 129.2	SE 11-18-49 Morrill3 128.4	SE 9-7-27 Frontier1 129	SE 28-13-33 Lincoln2b 127.5	SW 8-10-39 Perkins2b 128.3	NE 12-11-27 Lincoln3b 118.2	1217.0
NRCS Soil Type	Valent Sand	Valent Sand	Santana VFS L	Tripp F S L	Valent Sand	Daily L F Sand	Holdrege S L	Valent Sand	Kuma S L	Hoard S L	
Olsen Lab results	S on 5-29-12	S on 6-13-12	S on 6-4-12	S on 6-4-12	S on 6-27-12	S on 6-7-12	S on 6-12-12	6/11/2012	6/6/2012	5/29/2012	
Depth	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	1st NO3/Lbs/A	st NO3/Lbs/	1st NO3/Lbs/A	1st NO3/Lbs/A
Water H Cap. 0-12"	54	135	76	127	24	426	113	66.0	238	131	139
Water H Cap. 13-24"	94	92	35	22	19	297	28	17	53	47	70
Water H Cap. 25-36"	15	96	22	20	20	154	27	23	50	39	47
Water H Cap. 37-60"	137	102	68	31	31	234	46	19	51	51	77
Water H Cap. 61-84"											
Average	300	425	201	200	94	1111	214	125	392	268	333

Olsen Lab results	S on 7-17-12	7/20/2012	7-14-12	7-10-12	7-27-12	7-27-12	7-17-12	7/18/2012	7/31/2012	No sample	
Depth	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	2nd NO3/Lbs/A	nd NO3/Lbs/	2nd NO3/Lbs/A	2nd NO3/Lbs/A
Water H Cap. 0-12"	90	44	43	123	57	16	72	31	123		67
Water H Cap. 13-24"	20	35	29	25	26	12	34	17	48		27
Water H Cap. 25-36"	15	29	23	12	17	20	16	15	31		20
Water H Cap. 37-60"	35	42	45	24	28	24	33	58	52		38
Water H Cap. 61-84"											
Average	160	150	140	184	128	72	155	121	254		152

Olsen Lab results	10/19/2012	10-10-12	9/30/2012	10/11/2012	10/17/2012	10/17/2012	10/18/2012	9/20/2012	10/22/2012	10/18/2012	
Depth	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	3rd NO3/Lbs/A	rd NO3/Lbs/	3rd NO3/Lbs/A	3rd NO3/Lbs/A
Water H Cap. 0-12"	18	20	7	29	30	7	16	18	88	24	26
Water H Cap. 13-24"	6	9	3	17	14	5	7	3	26	13	10
Water H Cap. 25-36"	4	12	3	8	17	14	6	3	41	4	11
Water H Cap. 37-60"	18	36	3	14	45	18	7	13	50	9	21
Water H Cap. 61-84"	23	32	12	9	37	27	9	16	34	6	21
Average	69	109	28	77	143	71	45	53	239	56	89
Nitrate at risk	41	68	15	23	82	45	16	29	84	15	42
Cost/A @ $.656/Lb	$ 26.90	$ 44.61	$ 9.84	$ 15.09	$ 53.79	$ 29.52	$ 10.50	$ 19.02	$ 55.10	$ 9.84	$ 27.42
Cost/Field	$ 3,641.72	$ 5,923.94	$ 634.68	$ 1,866.39	$ 6,949.93	$ 3,790.37	$ 1,353.98	$ 2,425.56	$ 7,069.84	$ 1,163.09	$ 33,371.11
										Total	$ 86,588.85

Recommendations:

- Everyone involved with crop production needs to pay more attention to the timing of nitrogen applications.
- Consider adding inhibitors in early preplant applications of nitrogen as part of the budget.
- Consider applying most of the nitrogen through the pivot or with a ground rig close to when the crop requires the most. This should be a standard practice for sandy soils with low water holding capacity.
- Leaf sampling and soil sampling at various stages of growth should also be considered in the management strategy.
- When crops are not taking up nitrogen at the level they should be, it maybe an indicator that there is a plant health problem that needs attention such as nematodes.
- When placing the capacitance probes in the spring, core samples should be taken to a depth of 84" to see what the nitrate levels are at the start of the season. This will help us to better understand what is happening in the soil profile that may affect management strategies in the future.

Observations and conclusions:

- The probe vendors make the assumption that there is no limitation of water available to the crop. Through trial and error they have figured out through observation when the soil profile is at field carrying capacity. Once the full profile is determined irrigation recommendations are based on a percentage from full capacity.
- Regulatory allocation or limited well capacity may require deficit irrigation to maximize consumptive water use. Based on consumptive water use, the probe industry must become better at identifying where the crop wilting point is. Studies have been conducted to compare neutron probes with capacitance probes in order to become more effective in determining where the wilting point is with some degree of success. Further study is recommended to resolve that issue, especially if probes are used for regulatory compliance.
- At some point, probe vendors will have to meet certain minimum standards to meet consumer and regulatory expectations. NEWBA recommends that vendors, working together through their professional organizations, establish desired standards that will increase public acceptance. The standards would include proper installation procedures. Standardized measurements would be desirable such as the number of inches of water available between wilting point and full.
- Add a rain gauge on the probe telemetry to better measure how much water was applied to the crop, because sprinkler packages and irrigation pumps may not be meeting the original design.
- Residue management is critical in irrigation management and more needs to be done on both dryland and irrigated land to reduce evaporation and runoff loss.
- E- C and E-Mapping, along with VRI and in some cases Zone irrigation should be considered to improve water and nutrient management.
- If consumptive water use by the crop is our goal then we need to start thinking about recording real time data from the ETGages, flow meters or power companies, ceramic or capacitance probes, weather stations and possible satellite imagery, because consumptive use changes daily and must be recalculated daily.
- If a flow meter for irrigation is used it should be calibrated in acre inches. Then all the producer needs to do is divide the acre inches by the acres in the field to determine the amount applied.
- A team management approach by growers, to include crop consultants, seed representatives, vendors, UNL Researchers, power companies and others may be the best way to develop strategies that have long term viability for our future. The well managed operations are already implementing this concept with excellent results because they recognize they don't have all the answers.

- Cocktail cover crops deserve additional study as to how they might be of value to the overall management of the field.

Acknowledgements:

UNL researchers	URNRD
Moisture probe vendors	MRNRD
NEWBA staff	NPNRD
Power Company staff	TPNRD staff
Cooperators	Olsen Labs

All of the organizations involved contributed substantially.
Moisture probe interpretations and narrative in the report came from the vendors.
Power Company support staff was responsible for the Power Company information.
Growers & UNL ETGage website provided the information on the consumptive water use, rainfall and stage of crop growth.