Data Collection in the Lower Platte Basin

1.0 Data Collection, Sources, and Analysis

This technical memorandum documents existing data collection efforts as well as sources of existing datasets within the Lower Platte River basin. A data gap analysis is provided at the conclusion of this technical memorandum to document limitations in data discovered during the basin accounting analysis as well as provide suggestions for potential future data collection efforts that could support the Lower Platte River basin in individual NRD management activities as well as Coalition planning efforts.

2.0 Existing Datasets

Table 1 summarizes those agencies currently collecting and maintaining datasets within the Lower Platte River basin along with a description of the type of data being collected.

Table 1: Existing Datasets by Source

Existing Datasets	**UNL**	**Nebraska Statewide Test-hole Database** – information for about 5,500 test holes drilled since 1930 by the Conservation and Survey Division (CSD), School of Natural Resources (SNR), University of Nebraska, and cooperation agencies. The database includes test-hole location, lithographic descriptions, stratigraphic interpretations, and geophysical log records.	http://snr.unl.edu/data/geologysoils/NebraskaTestHole/NebraskaTestHoleIntro.aspx
		Groundwater-Level Monitoring Program – with the cooperation of 26 federal, state, and local agencies data is collected from more than 5,600 observation wells on at least an annual basis. Products available include maps depicting groundwater-level changes from year-to-year and maps depicting changes from predevelopment to current year. Other products include maps and reports depicting groundwater-level changes during the recent droughts. GIS data for this information is also available.	http://snr.unl.edu/csd/
		Nebraska State GIS Data – CSD and the Center for Advanced Land Management Information Technologies (CALMIT) of the SNR are actively engaged in assembling statewide digital databases. Shapefiles include geology, land use/land cover, soils data, principal aquifer, center pivots, and elevation & topography data.	http://snr.unl.edu/data/geographygis/
		Regional Evapotranspiration Estimation – Includes the High Plains Aquifer as well as the state of Nebraska mean annual evapotranspiration estimates estimated by the CREMAP method.	http://snr.unl.edu/data/water/evapotranspiration/regionalet.aspx
		High Plains Regional Climate Center (HPRCC) – Fee-based data retrieval system with access to entire AWDN data set, as well as the National Weather Service Cooperative Weather Network. Data for air temperature and humidity, soil temperature, wind speed and direction, solar radiation, and precipitation.	http://www.hprcc.unl.edu/services/index.php?p=online
	USGS	**National Water Information System -** (streamflow and water levels, groundwater level, water quality)	http://waterdata.usgs.gov/nwis
		National Hydrography Dataset (NHD)	http://nhd.usgs.gov/
	DNR	**Quality-Assessed Agrichemical Contaminant Data for Nebraska** – Contains ground-water nitrate and pesticide data that have been compiled from federal, state, and local agencies and the University of Nebraska. Each quality assessment level has criteria for evaluation of well location, well characteristics, sampling procedures and sample preservation, analytical method, field quality control, and laboratory quality control.	http://data.dnr.nebraska.gov/Clearinghouse/Clearinghouse.aspx
		Nebraska Stream-gaging – Available by request only	http://www.dnr.ne.gov/stream-gaging
		Nebraska Surface Water Data - Dams inventory, wetlands inventory, and surface water rights data retrieval	http://www.dnr.ne.gov/surface-water-data

		Registered Groundwater Wells Inventory	http://www.dnr.ne.gov/groundwater-data
		NeRAIN – Precipitation reports by volunteer recorders are transmitted via the internet to the NDNR daily. The NDNR prepares detailed maps showing rainfall patterns. Daily data available includes precipitation, snow depth, and temperature data.	http://nerain.dnr.ne.gov/nerain/
		Various Floodplain/Hydrologic Studies	http://www.dnr.ne.gov/publications
		Statewide Boundaries & PLSS Data	http://www.dnr.ne.gov/boundaries-plss
		Digital Imagery - 1993 through 2012 1 & 2 Meter	http://www.dnr.ne.gov/digital-imagery-1993-through-2012-1-2-meter
		Elevation Data - TVC, DEM, & 2 Meter Lidar	http://www.dnr.ne.gov/elevation-data
		INSIGHT Database[1] - streamflow, groundwater depletions, surface water demand, groundwater consumptive use (including CROPSIM), instream flow demand, hydropower demand, and canal seepage.	ftp://dnrftp.dnr.ne.gov/Pub/INSIGHTDocumentation/2015/DataAndDocumentation/
	USDA	**NRCS Land & Soil Data** – Lidar & Soil Survey Geographic Database (SSURGO)	https://gdg.sc.egov.usda.gov/ & http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
		Farm Service Agency (FSA)	http://www.fsa.usda.gov/
		NRCS/NASS Cropland Data Layers - Crop-specific land cover data created annually for the continental U.S.	http://www.nass.usda.gov/Research_and_Science/Cropland/sarsfaqs2.php
	Other	**NOAA-Climate Data Online (CDO)** – Provides access to the National Climatic Data Center's archive of global historical weather and climate data in addition to station history information. These data include quality controlled daily, monthly, seasonal, and yearly measurements of temperature, wind, and degree days as well as radar data and 30-year Climate Normals	https://www.ncdc.noaa.gov/cdo-web/
		USACE Mead Clean-up site	http://www.nwk.usace.army.mil/Missions/Environmental/EnvironmentalProjects/NOP/Results.aspx
		Omaha – Council Bluffs Metropolitan Area Planning Agency (MAPA) – Aerials, population & employment data, & traffic count data	http://mapacog.org/data-maps/
		Nebraska Department of Environmental Quality (NDEQ) - discharge and water quality data	http://www.deq.state.ne.us/
		ENWRA - ENWRA projects include Airborne Electromagnetic (AEM) surveys, Helicopter Electromagnetic (HEM) surveys, test hole drilling, and aquifer tests. Over 1300 flight lines have been flown to generate a geologic framework of eastern Nebraska (coarse grid) with test holes drilled to verify results.	http://www.enwra.org/

[1] INSIGHT documented data sources by subbasin attached to TM.

3.0 Existing Data Collection Efforts by NRD

In addition to the datasets collected by the agencies listed in Table 2, the member NRDs also engage in their own data collection efforts. The data collected and maintained by individual member NRDs are listed in Table 2.

Table 2: Data Collection Efforts by NRD

		Data Collection Efforts	Frequency/Format	Housed/Maintenance	Period of Record
Ongoing Data Collection Efforts	**Upper Loup NRD**	The Upper Loup NRD collects spring and fall water levels.	Bi-annual (Spring and Fall)		
		Flow meters are on new wells (post 2008)			2008 to present
		105 wells are monitored			
		Upper Loup NRD has finished certifying irrigated acres.			
	Lower Loup NRD	Infrared photography every fall (post 2008)			2008 to present
		Lower Loup NRD has finished certifying irrigated acres.			
		Lower Loup NRD is a member of the NeRain Network			
		450 Flow meters required in sub-area			
		Voluntary flow meter program cost shared on 160 meters to gather pumping data			
		Ongoing program to install monitoring/observation wells (currently 100 sites)			
		Lower Loup NRD collects 350 spring and fall static water levels.	Bi-annual (Spring and Fall)	Lower Loup database; UNL CSD	
		35 observed wells have data loggers installed.			
	Upper Elkhorn NRD	Upper Elkhorn NRD is in the process of certifying irrigated acres. These data are not yet available.			
	Lower Elkhorn NRD	The LENRD collects spring and fall water levels.	Bi-annual (Spring and Fall)	Upper Elkhorn database; UNL CSD	
		Water levels are also collected from 50 monitoring. Data loggers (i.e., continuously recorded water level measurements) are installed in 13 wells.		Upper Elkhorn database (separate from UNL CSD)	
		An aquifer test was performed as part of an ENWRA study at Oakland.			
		Sampling of riverbed materials has been performed in the Elkhorn River and several of its tributaries.			
		Lower Elkhorn is a member of NeRain network.			
		Piezometers are available around Willow Creek Lake, west of Pierce. These are for dam safety and water levels and are not transmitted to UNLCSD.			
		LENRD is in the process of certifying irrigated acres. These data are not yet available.			

	Lower Platte North NRD	The LPNNRD collects spring and fall water level measurements.	Bi-annual (spring and fall	LPNNRD database; UNL CSD	
		LPNNRD also collect late summer measurements on a select few wells in the Wann Basin area in the Platte and Todd Valley north of Ashland. This is part of a network to assist the U.S. Army Corps of Engineers (USACE), the Metropolitan Utilities District (MUD) and City of Lincoln on their groundwater modeling efforts.		LPNNRD database; USACE	
		Data loggers are installed in 24 LPNNRD monitoring wells. These are large files covering several years.		LPNNRD database (separate from UNL CSD)	
		The USACE has conducted numerous aquifer tests as part of their remediation studies of the Former Ordnance Plant near Mead, Nebraska. These tests were conducted in the Todd and Platte River Valleys.		LPNNRD database; USACE	
		Limited stream gauge readings were purposely taken during low flow conditions in August or September of the year.		LPNNRD database (separate from USGS)	1986 - 2000
		Lower Platte North NRD in the process of certifying irrigated acres. The process is ongoing.			
	Lower Platte South NRD	Spring and fall water level measurements are collected from approximately 150 wells. These data have been collected since the 1980s. Fifteen wells have transducers measuring levels 4 times a day downloaded quarterly	Bi-annual (spring and fall), with select wells monitored by transducers measuring 4 times daily	Housed in LPSNRD database; select well records submitted to UNL CSD	Various wells have bi-annual measurements going back to 1980s;transducer data from past several years
		Certification of irrigated acres is complete.	Certified irrigated acres checked and updated on a continuous bases	Housed in LPSNRD database	Initial certification completed in 2011; continuous update
	Papio-Missouri NRD	The PMNRD collect spring and fall water levels.	Spring and Fall/Database	P-MRNRD, UNL CSD, USGS NWIS	1974 – Present
		Light Detection and Ranging (LIDAR) survey work has been done in portions of the NRD. Additional LIDAR is planned through the Natural Resource Conservation Service (NRCS)	Single instance in rural areas and approximately every 6 years in urban areas/Multiple	MAPA, USDA Geospatial Data Gateway, NDNR GIS Databank	2004, 2010, 2012
		The Papio-Missouri NRD has finished certifying irrigated acres.	Single instance with updates through variance process/Scanned documentation of certification files (no spatial dataset created yet)	P-MRNRD	2009 – Present
		Historic well logs throughout eastern Nebraska (Dakota and alluvial definitions)			

4.0 Existing Studies/Tools

In addition to the datasets and data collection efforts previously described, the NDNR, USGS, and multiple NRDs have cooperatively engaged in the development of multiple groundwater models and independent studies. These models and studies are listed in Table 3.

Table 3: Existing Studies/Tools

Tools and Studies	**ELM**	The Elkhorn-Loup Model, developed by USGS in conjunction with 8 NRDs, is a study of surface-water and groundwater resources in the Elkhorn River basin upstream from Norfolk, Nebraska, and the Loup River basin upstream from Columbus, Nebraska.	http://ne.water.usgs.gov/projects/elm.html
	CENEB	Developed for the DNR, CENEB is a groundwater flow model for the Lower Niobrara, Loup, and Upper Elkhorn River Basins in Nebraska and part of southern South Dakota that utilized parts of the ELM model. The soil water balance model CropSim was used as the basis for estimating watershed inputs for the CENEB model. CropSim incorporates weather station data, land use, soil parameters, and crop water demands to estimate recharge, runoff, evapotranspiration (ET), and pumping demands through time.	http://dnr.nebraska.gov/iwm/ceneb-model
	Lower Platte & Missouri Tribs Model	DNR effort currently underway in development of groundwater model for the Lower Platte River basin (Shell Creek, Lower Elkhorn, Platte below Duncan, etc.).	http://dnr.nebraska.gov/iwm/lower-platte-missouri-river-study-area
	Lower Platte North NRD, Platte Valley Model	Chen, X. and Ou, G.: Development of Groundwater Flow Model for the Lower Platte North Natural Resources District Area, Nebraska,University of Nebraska-Lincoln, Lincoln, NE, USA, Unpublished Report, p. 110, 2013. As part of the Platte Valley modeling study, Dr. Chen conducted riverbed conductance testing on 11 sites in the Platte River. The study is under review and the final report has not been completed.	
	Ashland, Gretna, and Memphis GW Model	LPNNRD, LPSNRD, and PMNRD completed a ground water modeling effort using the Farm Process Model component of MODFLOW. This study covered the area around Ashland, Gretna, and Memphis.	
	Studies/Reports	McGuire, V.L., Ryter, D.W., and Flynn, A.S., 2012, Altitude, age, and quality of groundwater, Papio-Missouri River Natural Resources District, eastern Nebraska, 1992 to 2009: U.S. Geological Survey Scientific Investigations Report 2012–5036; 68 p.	
		Ayers, J.F. 1990. Hydrogeology of the Lower Platte Valley Alluvial Aquifer; Part 1: Geoelectric Survey. University of Nebraska-Lincoln, Conservation and Survey Division, Open File Reports.	
		Burbach, 2006. University of Nebraska-Lincoln Statewide Groundwater-Level Monitoring Program. Prepared by Mark E. Burbach, PhD Assistant Geoscientist, UNL.	
		Chatman and Associates, Inc, 2004. Well Field Groundwater Modeling Study. Metropolitan Utilities District. Platte West Well Field, Nebraska. Prepared for HDR, Inc. November.	
		Cheng, C., Song, J. Chen, X. and Wang, D. (2011) Statistical Distribution of Streambed Vertical Hydraulic Conductivity along the Platte River, Nebraska. Water Resources Management 25:265-285 (Report funded by LPNNRD)	
		Chen, X., Dong, W., Ou, G., Wang, Z., and Liu, C.: Gaining and losing stream reaches have opposite hydraulic conductivity distribution patterns, Hydrol. Earth Syst. Sci., 17, 2569–2579, doi:10.5194/hess-17-2569-2013, 2013. (Report funded in part by LPNNRD)	
		Gosselin, D.C., Harvey E.F., and Frost, C.D., 2001. Geochemical Evolution of Ground Water in the Great Plains (Dakota) Aquifer of Nebraska: Implications for the Management of a Regional Aquifer System. Ground Water 39 (2001) :98–108	
		HDR, 2011. Fully Appropriated Evaluation Methodology Development Technical Memorandum. Developed for the Nebraska Department of Natural Resources. November.	

		HDR, 2012a. Preliminary Data Review and Conceptualization of the Hydrogeology within the Lower Platte River and Missouri River Tributary Basins. April.
		HDR, 2012b. Nebraska Ordnance Plant Groundwater Report. Prepared for the Metropolitan Utilities District. January.
		Souders, V.L. 1967. Availability of Water in Eastern Saunders County, Nebraska. Conservation and Survey Div., University of Nebraska-Lincoln, Hydrologic Investigations Atlas HA-266.
		Summerside, S. A., Olafsen-Lackey, S., Goeke, J., Myers, W. 2005. Mapping of Aquifer Properties - Transmissivity and Specific Yield - for Selected River Basins in Central and Eastern Nebraska (OFR-71)
		Teeple, A.P., Vrabel, Joseph, Kress, W.H., and Cannia, J.C., 2009, Apparent resistivity and estimated interaction potential of surface water and groundwater along selected canals and streams in the Elkhorn-Loup Model study area, north-central Nebraska, 2006-07; US Geological Survey Scientific Investigations Report 2009-5171, 66 p.

5.0 Data Gaps

Stream gages, transmission loss study, drought management (monitoring wells in areas of losses)

5.1 Stream gages

For the Fully-appropriated methodology, the DNR divides the Lower Platte basin into eight subbasins based on watershed boundaries and existing stream gage locations. These subbasins include the following:

1) Elkhorn River Above Norfolk (HUC8: 10220001: Upper Elkhorn)
2) Elkhorn River Norfolk to Waterloo (HUC8: 10220002: North Fork Elkhorn; HUC8: 10220004: Logan; and HUC8: 10220003: Lower Elkhorn)
3) South Loup River (HUC8: 10210004: South Loup; and HUC8: 10210005: Mud Creek)
4) Middle Loup River (HUC8: 10210001: Upper Middle Loup; HUC8: 10210002:Dismal; and HUC8: 10210003: Lower Middle Loup)
5) North Loup River (HUC8: 10210006: Upper North Loup; HUC8: 10210008: Calamus; and HUC8: 10210007: Lower North Loup)
6) Lower Loup River (HUC8: 10210010: Cedar Creek; and HUC8: 10210009: Loup above USGS Genoa gage)
7) Platte River Above North Bend (HUC8: 10210009: Loup below USGS Genoa gage; and HUC8: 10200201: Lower Platte-Shell Creek)
8) Platte River North Bend to Louisville (HUC8: 10200203: Salt Creek; and HUC8: 10200202: Lower Platte)

For individual NRD management, it would be beneficial to include additional stream gage locations in the basin accounting to break the basin accounting along NRD boundaries. These are only suggestions that could be used to refine the basin accounting along NRD boundaries. Other methods may be utilized to assign supplies and demands between multiple NRDs within a single subbasin.

Suggestions for utilizing additional stream gage locations in the analysis or potential new stream gage locations include:

1) Existing USGS Station 0677500: Middle Loup River at Dunning, Nebr. or an additional gage on the mainstem Middle Loup above the Sargent Canal diversion to divide the Middle Loup subbasin between the Upper Loup NRD and the Lower Loup NRD.
2) Existing USGS Station 06781600: South Loup River at Arnold, Nebr. to divide the South Loup subbasin between the Upper Loup NRD and the Lower Loup NRD.
3) Existing USGS Station 06785500: North Loup River at Brewster, Nebr. or an additional gage on the mainstem North Loup River below this gage on the NRD boundary to divide the North Loup subbasin between the Upper Loup NRD and the Lower Loup NRD.
4) A new gage on the Calamus River at the Upper Loup NRD/Lower Loup NRD boundary.
5) DNR gage 'Elkhorn River near Tilden better aligns with Upper Elkhorn NRD/Lower Elkhorn NRD boundary.

6) New gage at the confluence of the Platte River and Clear Creek to better match the divide between the Lower Loup NRD and the Lower Platte North NRD
7) A new gage at the confluence of Wahoo Creek and the Platte River to better match the boundary between the Lower Platte South NRD and the Lower Platte North NRD
8) A new gage at the confluence of the Elkhorn River and Maple Creek to better match the boundary of the Lower Elkhorn NRD and the Papio Missouri NRD.
9) A new gage at the confluence of the Elkhorn River and the Platte River to better isolate the reach of Elkhorn River in the Papio Missouri NRD

5.2 Groundwater Depletions

The CENEB model described in Table 3 is currently being utilized to estimate groundwater depletions for the Elkhorn above Norfolk, North Loup, South Loup, Middle Loup, and Lower Loup subbasins in the current INSIGHT release. For the Lower Platte above North Bend, Lower Platte North Bend to Louisville, and Elkhorn Norfolk to Waterloo subbasins, the NDNR is currently utilizing groundwater depletion values from a 2013 HDR analytical analysis[2] as a groundwater model has yet to be completed for these subbasins. The Lower Platte & Missouri Tribs groundwater model described in Table 3 will replace this data once available.

5.3 Transmission Loss Study

Review of the streamflow gain/loss values from INSIGHT shows a negative trend in the Lower Platte above North Bend for both the Nonpeak and Peak seasons as well as a negative trend in the Middle Loup subbasin during the Nonpeak season and a negative trend in the South Loup subbasin during the Peak season, indicating that these are losing reaches. INSIGHT calculates streamflow gain/loss for each subbasin by taking the downstream streamflow gage less the upstream streamflow gage in order to isolate the gain/loss on a reach-by-reach basis.

As much of the Plan is focused on quantifying existing supplies and demands as well as identifying supplies available for water banking activities such as the transfer of water from an upstream source to a downstream user, it is important to consider the transmission losses of such a transfer. Limited data is available on transmission losses or streamflow interconnectivity between the Loup, Elkhorn, and Platte rivers. New studies to evaluate these losses and interconnectivity would be beneficial in determining the feasibility of such a transfer and whether a potential project to support such a transfer would be cost effective.

[2] HDR, Inc. 2013. Depletion Estimates for the Lower Platte River Basin, available on the Department's website and through the INSIGHT documentation