



**MARCH 28, 2023**  
**RED RIVER BASIN LIDAR DATA NOW AVAILABLE**

The Red River Watershed Management Board (RRWMB) is announcing the availability of Quality Level (QL) 1 LiDAR data for the Red River Basin (RRB) of Minnesota. The RRWMB contracted with The Sanborn Mapping Company Inc. (Sanborn) out of Colorado in 2021 to acquire LiDAR information over 20,034 square miles in Northwest Minnesota. LiDAR data collection began in October 2021 and was completed in early November 2021. A map of the collection area is included on the next page. LiDAR data collected by Sanborn was processed and submitted to the International Water Institute (IWI) in Fargo, North Dakota, also contracted with the RRWMB, to conduct quality control.

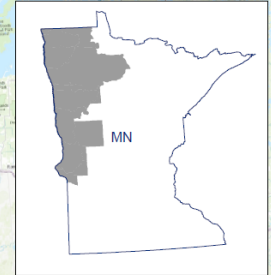
RRWMB partners and their stakeholders have been eagerly anticipating the roll-out of new LiDAR data. Robert Sip, Executive Director for the RRWMB said, “This was a long process due to the sheer amount of data that had to be quality controlled by the IWI. Over 60 billion data points or roughly 21 terabytes of LiDAR data files were delivered and processed as part of this effort.” More detailed information about project metrics is illustrated in the table below:

<b>Item – Metric:</b>	<b>Result:</b>
Number of Aircraft and Sensors Used	3 Terrain Mappers (91520, 91555, and 91559)
Number of Individual Missions	63 Separate "Lifts"
Total Square Miles Covered	20,034 Square Miles (51,888 Square Kilometers)
Size of Raw Data to Process	>800 Terabytes (0.8 Petabytes)
Size of LiDAR Files Delivered	~21.5 Terabytes
Number of Individual LAS Files Delivered	52,771 LAS Tiles (1 Square Kilometer Each)
Number of Total Project Files Delivered	960,536 Individual Project Files
Approximate Number of LAS Points (Project-wide)	<b>&gt; 60 Billion Points</b>

**Note:** There are four QLs from 0 to 3 according to United States Geological Survey (USGS) standards, with 0 being the best.

# 2021 Lidar Collection Areas

## Red River Watershed Management Board

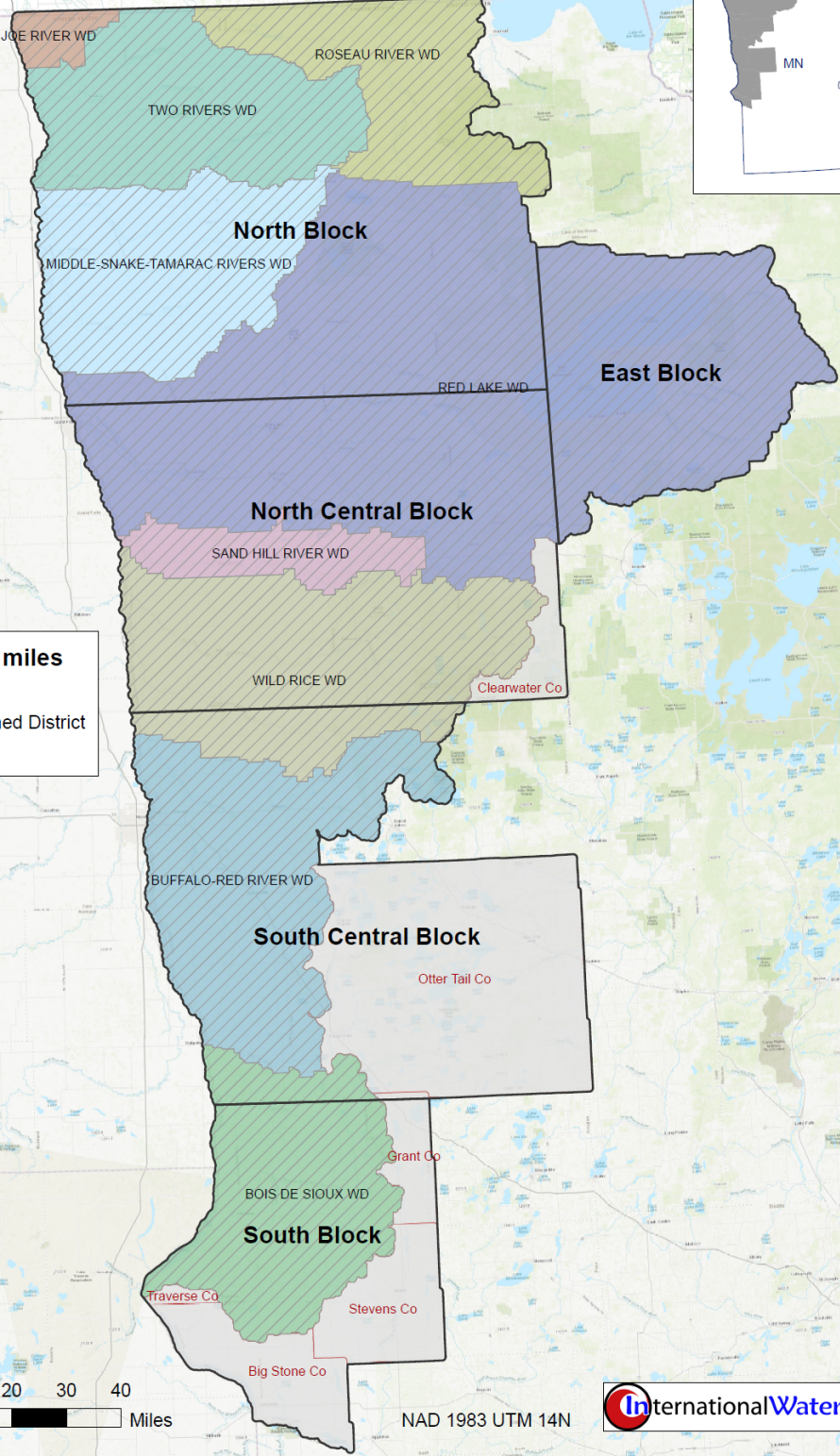
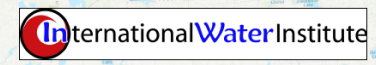


**Total Area: 20,034 square miles**

- Lidar Flight Block
- Area of Participating Watershed District
- Area of Participating County



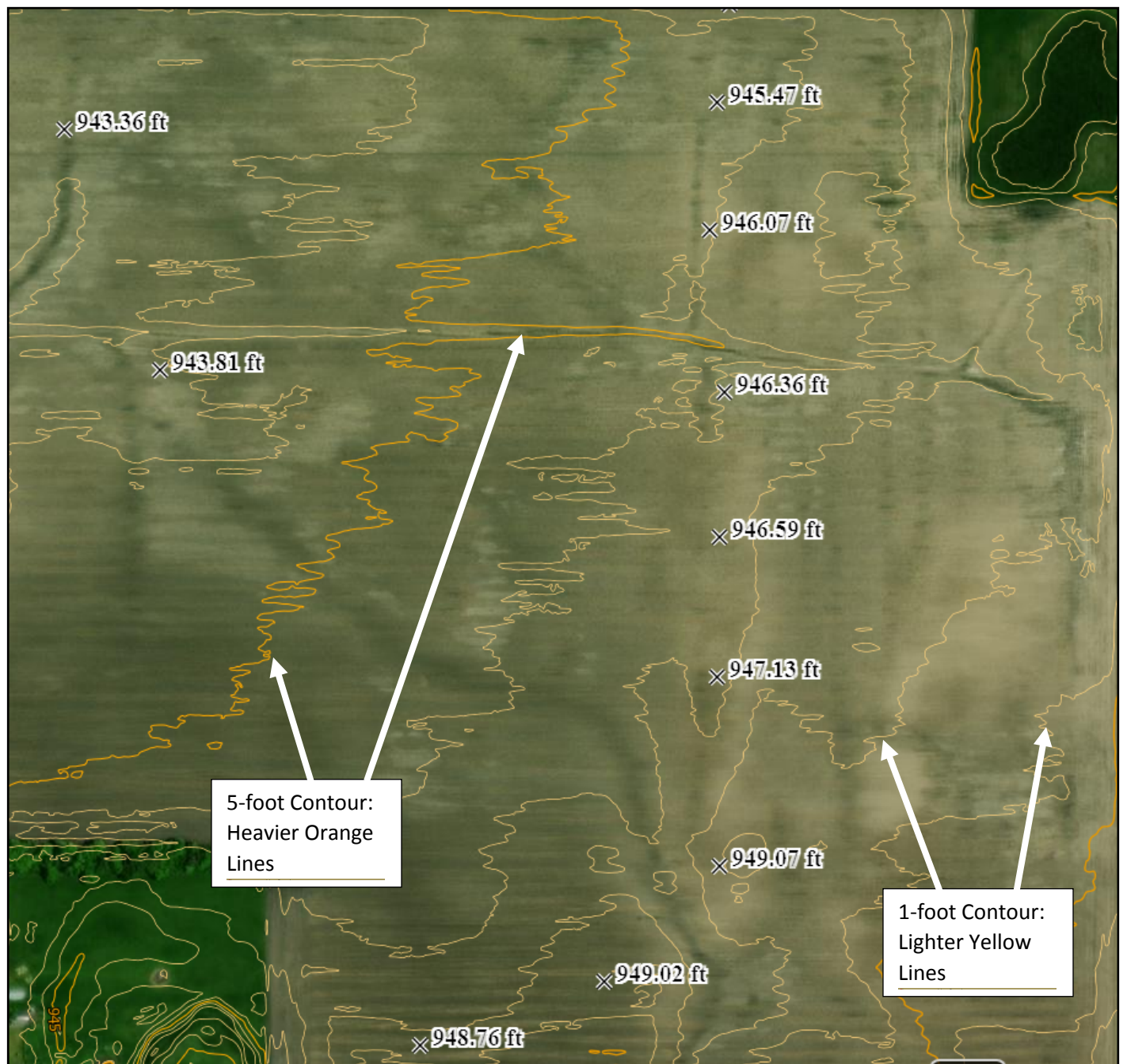
NAD 1983 UTM 14N



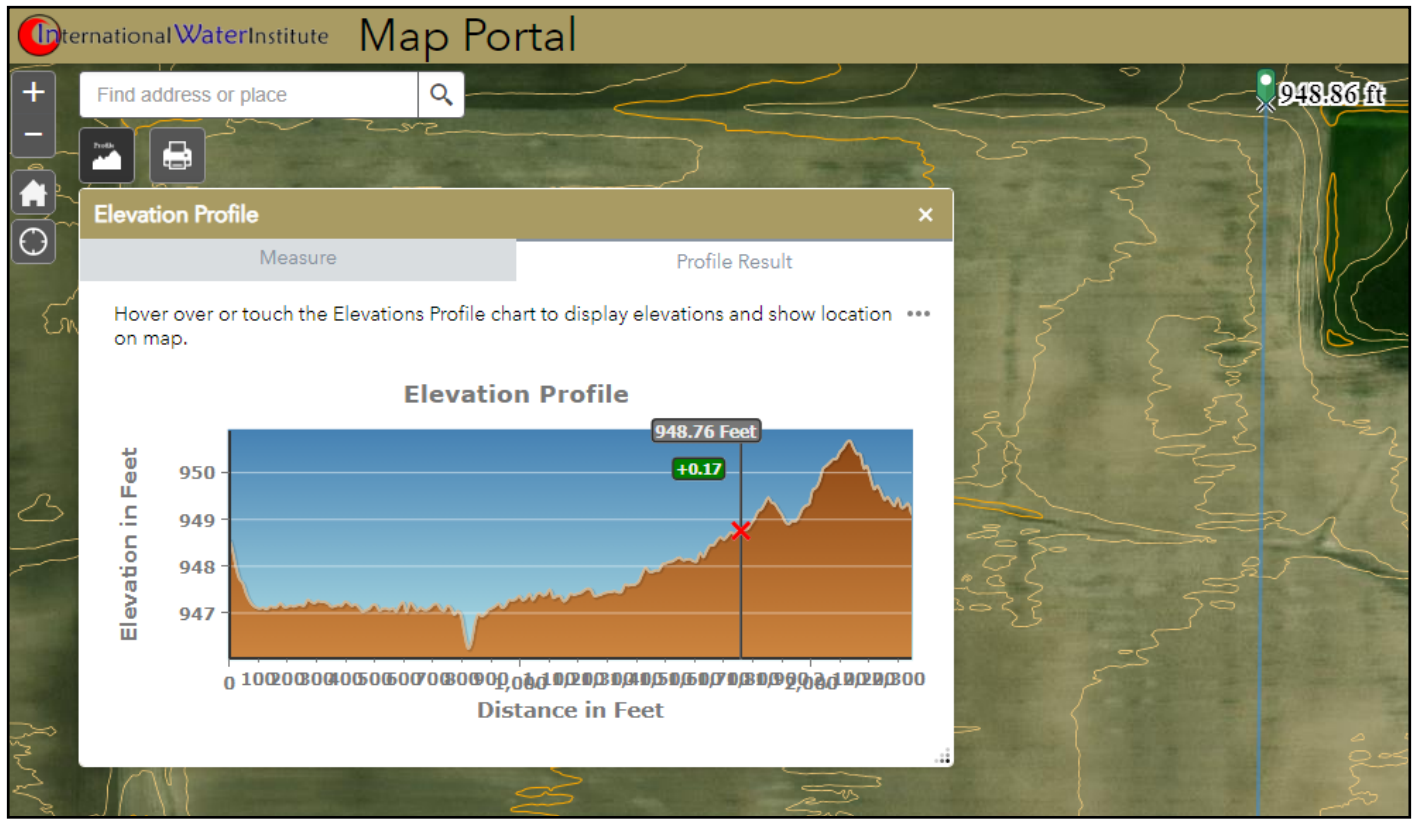


**What are the Deliverables of This Effort?** Product deliverables include the raw LiDAR point cloud, 0.5 meter Digital Elevation Model (DEM), building footprints, farmstead ring dikes, 1-foot contours, hydro-conditioned DEM, data storage for 4 years on the Sanborn Geodatabase Explorer, and updated data layers displayed on the IWI Map Portal at: <https://gisapps.iwinst.org/map-portal/>

The IWI Map Portal allows users to access the LiDAR derived bare-earth DEM, 1-foot and 5-foot contours, and a number of other LiDAR products such as shaded relief and water flow pathways. "A farmer or landowner can sit in their tractor using their smartphone or other electronic devices and can look at elevation data and contours in the fall while cleaning and maintaining ditches," said John Finney, RRWMB President and retired farmer from Humboldt, MN. Finney said that, "The IWI Map Portal is a point and click environment, is easy to maneuver around in, and you can't break it, plus spot elevation data can be found anywhere you click on a particular field or area of interest." Below is a map of a field from the IWI Map Portal depicting elevations and contours.



Elevation profile data can also be generated anywhere on a field by “snapping a line” on the map. The IWI Map Portal projects the horizontal elevation profile, which can be downloaded to a spreadsheet. Below is an example of an elevation profile in a field.

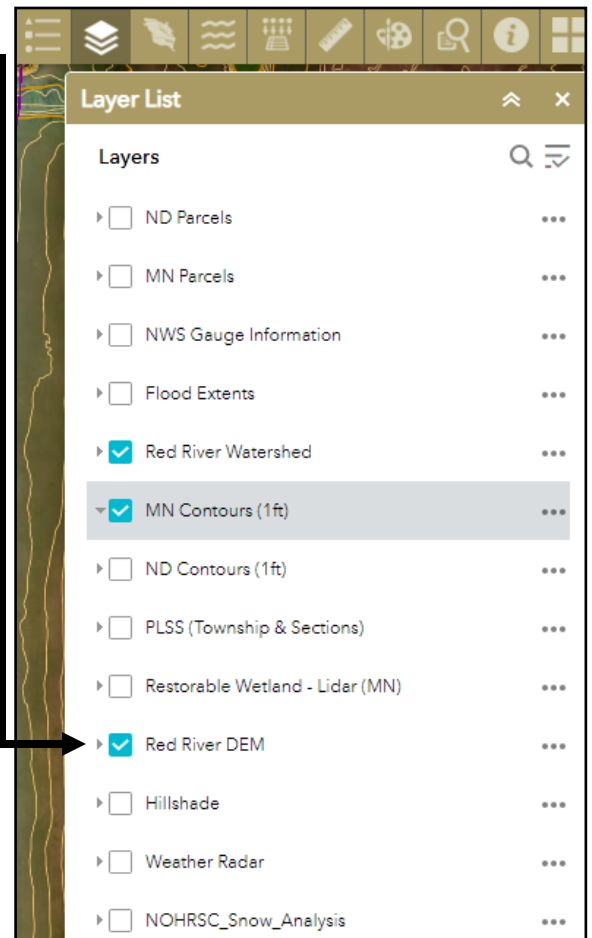


Detailed drainage patterns can also be viewed by turning on the Layer List and clicking on the DEM's within the Map Portal as seen in the illustration at right. The map on the next page depicts high resolution drainage patterns. Below are the buttons that can be used to toggle certain tools “on” or “off” within the Map Portal in the upper right of the website.

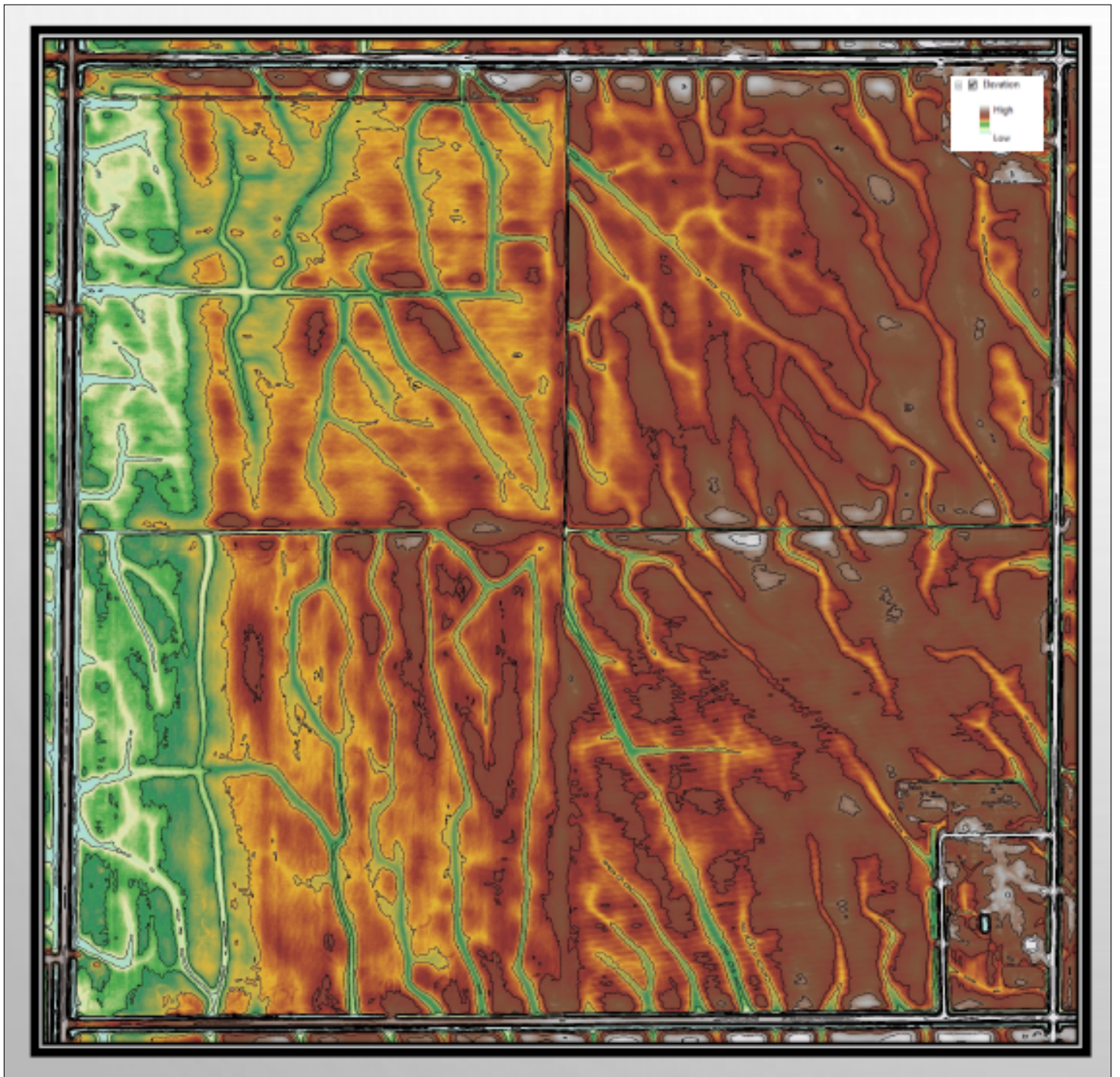


From left to right, the following buttons are:

- Legend
- Layer List
- Watershed Delineation
- Flood Inundation
- Elevation Labeler
- Measurement
- Draw
- PLSS Find
- About
- Basemap Gallery - Several years of aerial imagery are available here.







The original (2009) RRB LiDAR data had accuracy of approximately 6 inches while the new LiDAR data is less than 4 inches. The new data were collected according to federal standards developed by the USGS, which did not exist at the time of the original LiDAR data collection. About 50,000 square miles was collected in the original LiDAR data acquisition effort that included both the RRB of Minnesota and North Dakota.

Chuck Fritz, Executive Director of the IWI said that, “Today’s computing power, software, and technology has been a game changer for us compared to when the IWI worked on the original 2009 LiDAR.” Fritz further stated that, “In 2009 there were no QL Levels and no federal standards on quality control, data management, or data storage.” Fritz also indicated that the quality control process was quite involved and that the IWI needed to update their computer hardware to deal with the magnitude of the data. More information about the quality control process is available upon request to the RRWMB. The illustration on the next page compares the original 2009 data with the 2021 data.





# LIDAR Then and Now

October 2021



Aerial Reference Imagery

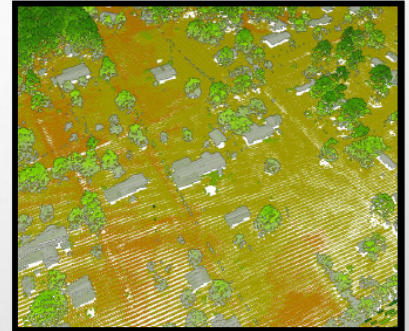
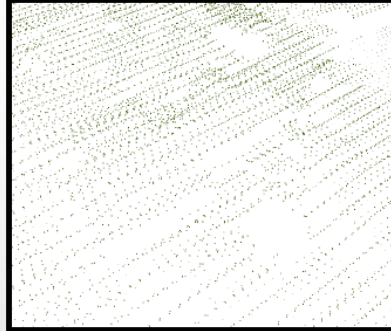
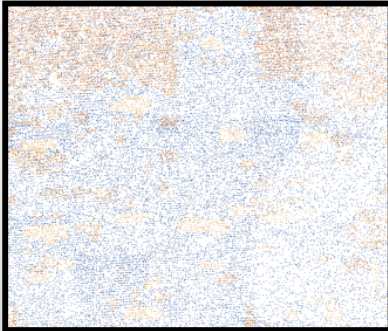


2D Overhead View

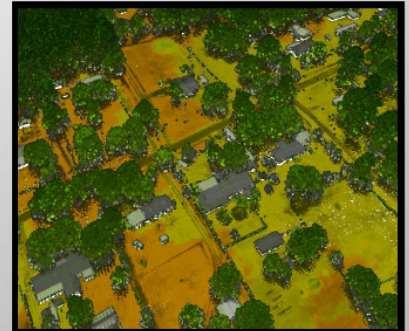
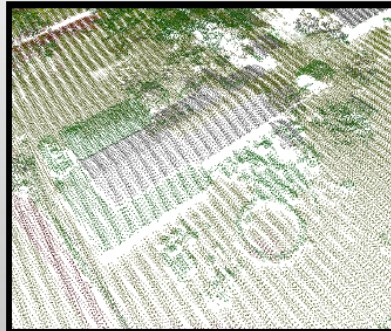
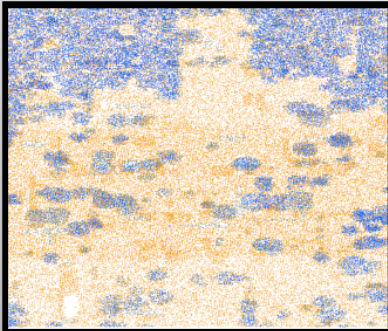
3D Lidar Point Cloud

3D Model

QL3 Data  
2008



QL1 Data  
2021

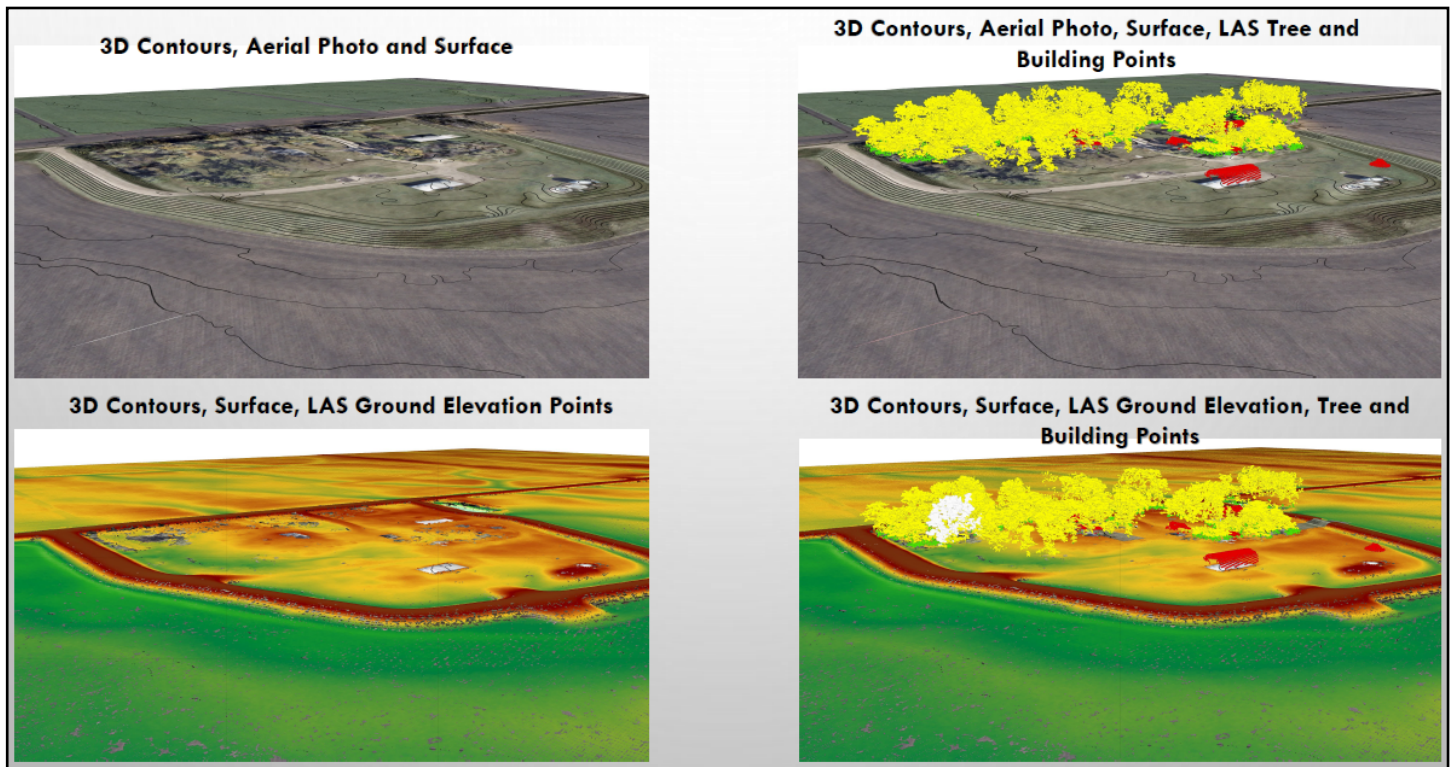


No special software is needed to view data in the IWI Map Portal, there is no fee, and no login and password required. “You don’t need to be a GIS or computer expert to use the IWI Map Portal, view or download data, or print maps,” said Sip. For power GIS users that have specialized GIS software and are wanting to work with the new LiDAR data, download imagery and other products, the data is housed at the Sanborn Geodatabase Explorer website. The data is free at this website but permission to access the data is granted by the RRWMB. The RRWMB requires a license agreement for accessing the Sanborn Geodatabase Explorer website, which requires a login and password. The RRWMB reserves the right to refuse access to the system.

**Ground Survey Control Points:** The Spring of 2022 saw large-scale flooding throughout the RRB of Minnesota and also North Dakota. As part of this project, over 800 on-ground survey control points had to be collected by a third-party contractor as part of the quality control process. Snowpack throughout the winter of 2021 – 2022 delayed the collection of survey data and the wet Spring of 2022 further complicated this activity.

**Farmstead Ring Dikes:** As part of the LiDAR collection and processing effort, ring dikes were mapped using both machine learning by Sanborn and computer visual inspection by IWI staff. The RRWMB has helped fund over 300 ring dikes but the new LiDAR data indicates that 658 farmstead ring dikes exist. Many of the RRB’s ring dikes have been funded through various funding sources including the RRWMB, member watershed districts, landowners, State of Minnesota, and federal government. The illustration on the next page depicts example imagery of a ring dike. Maps have also been made of each watershed district in the RRB of Minnesota illustrating the locations and numbers of ring dikes.





**Watershed Delineation Example:** The IWI Map Portal can also be used to delineate a watershed area for a drainage system. For farmers and landowners that want more detailed information about upland drainage flowing through a field of interest, the Watershed Delineation Tool can be used and here are some quick and easy steps to follow:

- **Step 1:** Select the Watershed Delineation Tool in the upper right corner of the IWI Map Portal.
- **Step 2:** Zoom into the area of interest in a field.
- **Step 3:** Select watershed that you are interested in from the Watershed section.
- **Step 4:** Ensure the "Flow Paths" layers are turned on for reference in the Watershed section.
- **Step 5:** Select the line tool and draw a line intersecting a feature on the Flow Paths layer.

### Watershed Delineation ⤴ ✕

Instructions ⤴

**Step 1:** Select watershed from the Watershed section.

**Step 2:** Ensure the "Flow Paths" layers are turned on for reference in the Watershed section.

**Step 3:** Select the line tool and draw a line intersecting a feature on the Flow Paths layer.

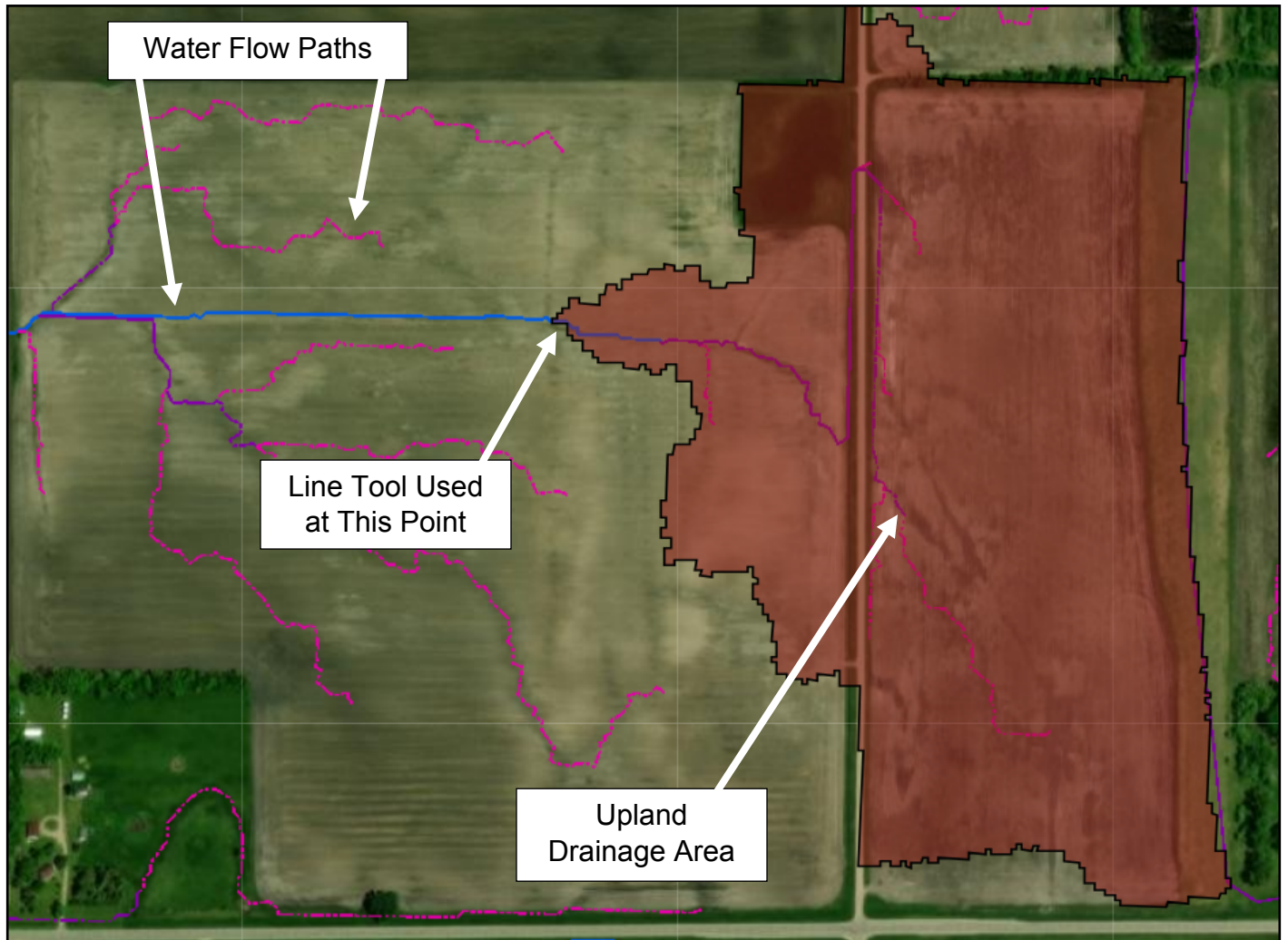
Watershed ⤴

Wild Rice / Marsh River, MN

- 🔍 Wild Rice / Marsh River, MN
  - Watershed Hydrologic Boundary
  - Water Flow Paths by Drainage Area
  - Field Scale Flow Paths By Drainage Area
  - Non-contributing basins/depressions (100yr)
  - Non-contributing drainage areas (100yr)
  - Catchments

N

Once these steps are followed, a map is generated and the example below shows the watershed or drainage area for a specific area of a field.



GIS shapefiles can be downloaded and used in GIS software for the area of interest and the hydrology report can be generated by clicking on the buttons below:

A screenshot of a GIS application interface. At the top, there is a toolbar with icons for a checkmark, a magnifying glass, a download arrow, a document icon, and a close 'X' button. Below the toolbar, a popup window displays the following information: 'Wild Rice / Marsh River, MN', 'Outlet Coordinates (UTM Zone 14)' with X: 698127.50 and Y: 5241977.50, and 'Watershed Area 0.13 sq. miles.'. At the bottom of the popup, there is a note: '\*Reports will open in popup so please ensure popups are not blocked.'. Two black arrows point from the text above to the download and document icons in the toolbar.

**NOTE:** The Watershed Delineation Tool and Hydrology Report currently uses the 2009 LiDAR data. The IWI has to “Hydro-condition” the DEM’s using the 2021 LiDAR data before the data can be included in the IWI Map Portal. Hydro-conditioning DEM’s is a time-consuming task and the Map Portal will be updated when new data becomes available.



**Who Else Will Use This Data?** Watershed managers, their technical staff, and consultants will use the new LIDAR data for several purposes including but not limited to review drainage permits, re-determination of ditch system benefits, conduct preliminary watershed delineations or assessments, determine or redetermine watershed boundaries, and for overall water management purposes. QL1 LiDAR data will enhance resiliency, capacity, performance, and efficiency at every level of decision-making.

Jamie Beyer, Administrator of the Bois de Sioux Watershed District in Wheaton, Minnesota said, “Our landowners are very excited to access and use this information, to increase the accuracy of their in-field ditch efforts.” Other known benefits from LiDAR data include but are not limited to:

- More accurate flood plain maps to mitigate flood damages and to work towards flood and drought resiliency.
- Enhanced emergency preparedness.
- Targeted wetland and wildlife habitat restoration.
- Enhanced planning and project development related to transportation infrastructure, land use management, and human development.
- Enhanced understanding of river channel migration and slope stability.
- Detailed surface hydrologic and hydraulic modeling.
- Efficient/equitable natural resources management.
- Increased agricultural productivity.
- Innovative tools for conflict resolution.
- Problem identification.
- Cost reduction in all civic projects.

**Who Paid for This Effort?** The RRWMB, non-member watershed districts, and counties paid for this project using local taxpayer dollars from the RRB of Minnesota. No state or federal funds were used and the total project cost was approximately \$2.4 million or \$135/square mile. Current state/federal managed LiDAR projects can be over \$300/square mile. The RRWMB plan is to share the RRB LiDAR data with the USGS for inclusion in the national LiDAR dataset and the State of Minnesota. Sip noted that unfortunately, the USGS has plans to recollect LiDAR data for the RRB of Minnesota in Spring 2024.

**What if I Want LiDAR Data on a Hard Drive?** If data is requested to be placed on portable hard drives, there will be fees for the cost of hard drives, staff time from the IWI to place data on hard drives, postage, supplies, and processing fees. Contact the RRWMB for more information.

**Contact Information:**

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