

Contract No. G-041-082

“Effects of Cropping Sequence, Ripping, and Manure on Pipeline Reclamation in Western North Dakota”

Submitted by: North Dakota State University - Williston Research Extension Center

Principal Investigator: ~~Austin Link~~ Jerry Bergman

PARTICIPANTS

Sponsor	Cost Share
North Dakota State University	\$ 517,968
North Dakota Industrial Commission/OGRC Funding	<u>\$ 517,968</u>
Total Project Cost	\$1,035,936

Project Schedule – 4 years
Contract Date – March 4, 2017
Start Date – January 2017
Final Report: December, 31, 2020

Project Deliverables:
Status Report: May 1, 2017
Status Report: September 1, 2017 ✓
Status Report: December 31, 2017 ✓
Status Report: May 1, 2018 ✓
Status Report: September 1, 2018 ✓
Status Report: December 31, 2018 ✓
Status Report: May 1, 2019
Status Report: September 1, 2019
Status Report: December 31, 2019
Status Report: May 1, 2020
Status Report: September 1, 2020
Final Report: December 31, 2020

OBJECTIVE/STATEMENT OF WORK:

The North Dakota State University Williston Research Extension Center proposes a 4-year study to address several agronomic and ecological issues that result from pipeline installation such as:

- Mixing of topsoil with subsoil changes texture and other physical and chemical characteristics of the reapplied soil surface.
- Compaction (bulk density) of topsoil and the underlying matrix restricts root growth and plant development.
- Soil organic matter and beneficial soil organisms are reduced in disturbed soils.

Work to be accomplished in this study includes:

- Conducting a field-based study at the Williston Research Extension Center on a section of recently installed pipeline.
- By sampling soil characteristics and crop performance evaluate the effectiveness of multiple annual cropping sequences and perennial vegetation covers to improve soil health and crop performance.
- Evaluate ripping (deep tillage) and manure incorporation because it is not known if aggressive, deep rooted crops can improve severely compacted soils in a reclamation setting.
- All cropping sequences, ripping and manure will be applied across different disturbance areas which commonly exist on pipeline Right-of-Ways. The identified areas are the pipeline trench, access road (parallel to the trench), and undisturbed area (reference area). Each area exhibits unique soil characteristics that may require different long-term reclamation practices to be sustainably returned to agronomic productivity.

The Deliverables will include:

- Best management practice (BMP) document for reclamation of lands impacted by pipeline installation;
- Peer-reviewed publications to help policy makers develop sound guidelines for proper pipeline reclamation;
- Presentations at the annual reclamation conference;
- Presentation of final report to industry representatives at the Williston Experiment Station;
- Final report from all experiments conducted during this study.

STATUS

The Oil and Gas Research Council and the Industrial Commission approved the funding for this project with the condition that a task force be established with industry and North Dakota Department of Mineral Resources representation to assist with the study process, presentations be made at the annual reclamation conference and a presentation of the final report be given to industry representatives at the Williston Experiment Station.

The Contract has been executed by the Commission and forwarded to NDSU for their consideration.

The Contract has been fully executed.

August 24, 2017 - Status Report received. It states in part:

During the spring of the 2015, installation of a water pipeline was completed at the North Dakota State University, Williston-Research Extension Center. A long-term experiment with five annual crop rotations and two perennial covers was planted in pipeline, roadway (parallel to pipeline), and undisturbed (control) areas. We aim to determine best cropping sequences under dryland no-till conditions that reclaim severely disturbed cropland. In addition to cropping sequence, ripping/manure will be tested as the subplot in a split plot design in efforts to decrease compaction and add organic matter. This study is designed to address barriers to successful pipeline reclamation. More specifically, this study aims to provide long-term management strategies for landowners to restore productivity to cropland. If economical reclamation options are available to stakeholders, more effective reclamation plans can be composed and more efficient pipeline installations will be possible.

Status Update: Severe drought stress contributed to reduced crop performance across all treatments.

- June
 - Cover crop mix was planted.
 - Alfalfa biomass was collected and processed for the first cutting.
 - NDVI* and other imagery began being collected weekly.
 - The PI (Austin Link) and Karlene Fine have been in communication about forming a task force associated with this study and its dissemination.
- July
 - July 13th. The funded project was showcased at the Williston REC Annual Field Day. Co- PI (Dr. Tom Desutter) and Assistant Professor of Soil Health-Research, Dr. Caley Gasch lead presentations and discussion utilizing soil pits.
 - NDVI* and other Imagery were collected weekly.
 - Phenological data were collected on annual crops (Safflower, Barley, and Durum)
 - Alfalfa biomass was collected and processed for the second cutting

- August
 - Phenological data were collected on annual crops (Safflower, Barley, and Durum)
 - NDVI* and other Imagery were collected weekly until crops reached maturity
 - Barley and durum was harvested.
 - Soil moisture sensing equipment was ordered and will be installed for the 2018 growing season.

December 21, 2017 - Status Report received. It states in part:

Status Update:

- September
 - Harvest of all annual and perennial crops was completed.
 - Compaction data was collected using a dynamic cone penetrometer.
 - Soil sampling was completed with the assistance of NDSU Soil Dept. staff.
 - Soil moisture monitoring equipment was purchased (to be installed post-planting 2018)
- October
 - Pre-plant residual herbicides were applied to annual crop treatments.
 - Processing of all combined yield samples was completed.
- November
 - Preliminary findings were orally presented at 2017 International Soil Science Society of America Meeting.
- December
 - Biomass processing was completed.
 - Early stages of planning have begun for annual reclamation training/workshop to be held at the Williston Research Extension Center.
 - Several members of industry have expressed interest in reclamation training.

May 1, 2018 - Status Report received. It states in part:

- January

Processing of 2017 soil samples at NDSU Soil Dept. commenced
Initial invitations were sent to prospective members of a Reclamation Task Force
- February

Planning for 2018 cropping sequences, moisture sensing equipment installation and data collection
- March

Preliminary findings presented at the 2018 Western Crop & Pest School in Williston, ND.
- April

April 5 - 2018 Land Reclamation Workshop for Industry was held at the Williston Research Extension Center. Speakers included Dr. Tom DeSutter (NDSU Soil Dept.), Dr. Kevin Sedivec (NDSU Extension), Chris Augustine (NDSU Extension), Samantha Croat (NDSU Graduate Student, Austin Link (WREC Research Specialist), and Kevin Connors (Department of Mineral Resources). Land Reclamation Workshop was exclusively aimed at members of industry and provided specific sessions on best reclamation practices and generated constructive discussion among industry peers and researchers.

September 1, 2018 - Status Report received. It states in part:

Increased precipitation resulted in subsidence within the pipeline trench

- May
Pre-plant herbicide applied.
Durum and Safflower treatments were planted.
Soil moisture access tubes installed and data collected.
- June
Cover crop mix was planted.
Alfalfa biomass was collected and processed for the first cutting.
Physiological data was collected on durum and safflower (height and maturity).
Soil moisture data was collected.
In-crop herbicide applied.
- July
July 11th - The funded project was showcased at the Williston REC Annual Field Day.
Physiological data were collected on durum and safflower (height and maturity).
Alfalfa biomass was collected and processed for the second cutting, and perennial grass harvested.
Soil moisture data was collected.
- August
Physiological data were collected on safflower and durum (height and maturity).
Durum was harvested.
Soil moisture data was collected.

October, 2018

A request was made to change the Principal Investigator from Austin Link to Jerry Bergman, Director of the NDSU Williston Research Extension Center. The Commission has approved this change in the Principal Investigator.

December 5, 2018 - Status Report received. It states in part:

- September
Safflower was harvested
Soil moisture data was collected.
Soil sampling was completed with the assistance of NDSU Soil Science Dept. staff.
- October
Cover crop biomass was collected and processed.
Soil moisture data was collected.
Alfalfa was sprayed with herbicide as next year only a single crop will be planted.
Pre-plant residual herbicides were applied to annual crop treatments.
- November
Durum samples were processed for yield and protein content.
Safflower samples were processed for yield and oil content.
Data analysis was completed for durum and safflower yields.
Soil moisture data was analyzed.