Before we start.....

- WRRC 2\textsuperscript{nd} Land Reclamation Symposium June 1-8 in Laramie, WY
  - Contact Kristin Herman: kherman@uwyo.edu (phone 307-766-3576).
  - Others?
SOIL MANAGEMENT – LINEAR DISTURBANCES

PIPELINE RECLAMATION WORKSHOP
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What is a linear disturbance?

- Pipelines
- Roads
- Railroads
- Transmission Lines
- Others?
Pipeline Reclamation Challenges

- Narrow workspace
- Crosses numerous landowners
- Access to any one point may be difficult
- Weed control may be problematic
Two major challenges to linear disturbances

- Scale of disturbance
- Crossing multiple landscapes, soil types, and vegetation types
FIRST MAJOR CHALLENGE

Scale
Pipelines

- ROW width and total length of pipeline can range from **small** to **large**?
Same with Roads...
Examples of multiple ROW’s
SECOND MAJOR
CHALLENGE
Multiple Landscapes
NRCS Order 3 Soil Mapping
NRCS Ecological Site Mapping

EXAMPLES ON THIS MAP
Loamy vs. Shallow Loamy
Clayey vs. Sandy
Lowland

COULD ALSO HAVE:
Rocky soil at or near the surface
Saline phases
Terrain Challenges
Extent Challenge

Keystone Pipeline

Ruby Pipeline

Interstate as well as intrastate
How to deal with those challenges?
Soils is more than just an erosion hazard map!
Understand Soils
Starting with the Basics

- Complex, dynamic, living system
- Changes to one property category will impact the other two
Chemical Properties

- pH
- CaCO₃
- Metal toxicity based on climate and geology
  - Selenium for example
- Salinity and/or sodicity
  - Seep areas
- Fertility
- Organic matter (physical property also)
Physical Properties

- Texture
- Bulk density
- Compaction
- Structure
- Organic Matter
- \( \text{O}_2 \) concentration
  (waterlogged soils)
Why is it important to salvage and segregate that top layer?
Importance of organic matter

- Provide soil fertility
- Provides energy sources for soil microorganisms
- Helps to kick start biogeochemical cycling
- Top horizon material can be a seed source (both good and bad)

A little bit goes a long way
Biological Properties

- Last but certainly not least
- Generally soil microbial populations or biota
- Biogeochemical cycles (nutrient cycling)
How does soil form?

Soil Formation

- Climate
- Organisms
- Relief
- Parent material
- Time

Processes

Soil Properties
Climate Maps of the US

Mean Annual Precipitation

Mean Annual Air Temperature
Humid Continental Climates

- Warm, humid summers
- Cold, wet winters
- Fertile, high organic matter soils
  - Classified as Mollisols
- Dominant soil order in ND
Mollisol Landscapes
Mollisol Profile
Semi-Arid Climates

- Less precipitation than potential evapotranspiration
- Dominated by other soil orders
  - Likely Entisols, Inceptisols, Aridisols
Typical Aridisol Landscape
Aridisol Profile
Typical Entisol Landscape
Glacial Impacts in ND (and northeastern MT)
Types of Large Scale Man-made Disturbance

• Mining
  - Surface Coal
  - Underground Coal
  - Surface Uranium
  - In-situ Uranium
  - Bentonite
  - Gravel
  - Abandoned mines
Types of Large Scale Man-made Disturbance (continued...)

- Oil and Gas pads
  - Coalbed methane
  - Tight oil shales
  - Deep gas
- Roads
- Pipelines
Don’t forget gravel or sand quarries needed to support activity.
Undisturbed Soils - General

- High biological diversity
- Horizonation
- Organic layer intact
- Defined chemistry
- Greatest resilience to stress
- Always in flux, but generally stable
- Low biological diversity
- No horizonation; could be inverted or totally mixed
- Organic layer diluted
- Changes in chemistry
- More open to erosion, both wind and water
- Unstable
Soils under Disturbance

- Increased bulk density
- Decreased soil structure
- Decreased aeration
- Decreased infiltration and moisture holding capacity
- Reduced nutrient cycling
- Reduced microbial activity
Hydraulic Implications

- Decreased infiltration, percolation, water holding capacity
- Increased rates of erosion
Ways to minimize impact of oil and gas (including pipeline) activity to the soil
General Ways to minimize impacts – 4 phases

- Planning
- Salvage
- Storage
- Replacement
Map your soils for suitable seedbed material, know where you might be able to take more and know your trouble spots.
Suitability line will likely vary over the landscape.

Uniform depth may not apply.
Look for unstable slopes and avoid them
General ways to minimize impact

- Planning
- Salvage
- Storage
- Replacement
Ways to minimize impact

- Know what you are dealing with prior to disturbance…back to planning
- Segregate true topsoil from suitable subsoil to minimize dilution
- Salvage under optimal conditions… not when wet
Look around... POTENTIAL SEDIMENT LOAD IN DRAINAGES
Don’t do this!

Note when the frost goes out of the ground! Important with seismic activity too.
Understand that suitable soil depth varies...uniform soil depth removal is not optimal use of a resource. Suitable soil may be salvaged with heavy equipment.....

.....or a SPOON!
On pipelines, maintain boundary of topsoil/suitable material and geologic material.
General ways to minimize impact

- Planning
- Salvage
- Storage
- Replacement

NOTE: Due to temporary nature of pipelines, may or may not apply.
Ways to minimize impact

- Direct haul and replace, if possible, rather than stockpiling
- Minimize storage time
- Salvage during colder, drier months
- Will likely not apply as much to pipelines
Ways to minimize impact

- Stabilize and protect from wind and water erosion
- Temporarily seed stockpiles if greater than 3 months to add organic matter, aid microbial populations, and reduce weeds
40 foot stockpile

- Minimize depth of stockpiles, if possible
- Consider space needed and length of time in storage

25 foot stockpile

3 foot stockpile
Large vs. Small Stockpiles

- Large piles – Common in coal industry
  - Less exposed surface area
    - Overall, less susceptible to erosion
  - Overall smaller disturbance footprint
  - Likely longer term if not direct hauled

- Small piles – Preferred by BLM on O&G sites
  - More exposed surface area
    - More susceptible to erosion
  - Overall greater disturbance footprint
  - More of a temporary nature
  - May be able to store onsite as part of interim revegetation
Stockpile seeding

- Seed topsoil stockpile immediately
- Annual cover crop (different term in agriculture)
- Erosion control methods
  - Earthen berms
  - Limit slope percentage
  - Channels/Ditches
Research findings

- 15-20 year old topsoil piles still biologically healthy
  - Contrary to common thought of “dead” piles
- Microbes in semi-arid and arid climates enter dormancy when stressed
  - Very adaptive to droughts
  - Quickly rejuvenate in proper conditions
  - Reseeding (timing, mix, etc.) and available moisture
- Keep movement and disturbance to stockpiles to a minimum
  - Quality degraded during transportation
General ways to minimize impact

- Planning
- Salvage
- Storage
- Replacement
Ways to minimize impact

- Deep rip compacted areas
- Lightly rip or roughen underlying material
  - Especially on slopes
- Avoid handling wet material
- Stabilize replaced material prior to seeding, e.g., rough
Need to handle large rocks...
Likely Chemistry Changes
Seeded Topsoil
Consider mowing Russian thistle instead of spraying.

Gives seedlings some extra cover for increased moisture availability.
Reduces the disturbance footprint!
Reseeding

- Timing
  - Conditions
    - Seasonal
    - Moisture
    - Drought?
- Seed mix
- Interim stabilization
- Inoculation of soil microbial activity
  - Local source
  - Wind/Dust
Federal Road Considerations

- On federal ground, construction and maintenance of roads will conform to the BLM Gold Book and BLM 9113 Roads Manual
- Interim vs. final reclamation on BLM
- Depending on use, could have these types of roads on BLM:
  - Primitive
  - Resource
  - Local
  - Collector
Highways through DOT’s

- Objectives may differ from BLM:
  - Long term stability
  - Little or no maintenance
  - Weed suppression
  - Do NOT attract large game
  - Attraction of bird species acceptable but not high priority
  - Attractive landscape
  - Ecological correct – “native” species utilized
REMEMBER…Challenges include crossing multiple soil types, land uses, plant communities, producers, etc.
First step in reclamation is planning the linear disturbance

Items to consider:
- Soil erosivity
- Snow catch
- T&E concerns
- Drainage
- Other
- Original placement, if possible, should
  - Take reclamation potential into consideration
  - Follow existing disturbances
- Topographic position plays a part in overall reclamation potential
- Can drainage crossings or other problem areas be avoided?
Topsoil Reapplication and Seedbed Preparation

- Determine depth of compacted layer
  - Actual depth may vary
- Rip compacted layer prior to reapplication of topsoil
  - Don’t turn over top layer
- Rippers should be no more than 24 inches apart
- Leave a rough surface prior to topsoil reapplication
- Prepare “suitable” seedbed, i.e., firm
Leave a Roughened Seedbed

- Prevent wind erosion, encourage moisture catchment, discourage driving over seeded areas
- Important on steep slope and/or erosive soils
- Additional roughening may be accomplished by:
  - Pitting, gouging, scarification, dozer track-walking
  - Discourage recreational use
- Place erosion protection features on the contour and perpendicular to the prevailing wind and water flow
Benefits
- Minimizes mixing topsoil and subsoil
- Reduces topsoil compaction
- Allows for work in wet conditions

Disadvantages
- Requires increased workspace, time and equipment
- Vegetation root structure is disturbed across entire ROW
- Stabilization and stockpiling of large volumes of topsoil
**Topsoil Stripping Methods**

**Trench & Spoil Side**

- **Benefits**
  - Requires less workspace, time, and equipment than full-width method
  - Vegetation root structure is disturbed only in the travel lane

- **Disadvantages**
  - Increased mixing of topsoil and subsoil
  - Increased compaction of ungraded travel lane
  - Limited access during wet conditions
  - Spoil storage options reduced
Topsoil Stripping Methods
Trenchline Only

- **Benefits**
  - Requires a minimum amount of time, workspace, and equipment
  - Vegetation root structure is preserved

- **Disadvantages**
  - Impractical on side-slopes or rough terrain
  - Increased mixing of topsoil and subsoil
  - Increased compaction over ungraded travel lane
  - Limited access during wet conditions
Subsidence issues

- Do not backfill frozen soil
- Anticipate settling and account for extra material over the trench itself
Potential soil problems on the backend on all linear disturbance

- Metal toxicity
- Salinity or sodicity or both
- Compaction
- Instability
- pH issues
- Fertility

Pay Now or Pay Later!!!
As a private landowner...

- Know your ranch
  - Where are the potential problem areas
  - Where are areas to be avoided
  - Where is the best reclamation potential
  - Ask if ROW width can be minimized in sensitive areas
  - Document what you desire
  - Take photos from same location, if possible
- Be available when activity is on your place
- Get to know your pipeline representative and your construction foreman
  - Don’t assume that conversation will be passed to the next person
Progression of pipeline
Minimize landscape and scale challenges

- Get the “big view”... know problem areas
- Design your seedmix around anticipated ecological sites and overall soil conditions
Minimize landscape and scale challenges (cont.)

- Minimize width, if possible, in sensitive areas, e.g., wetlands, sandy areas, etc.
- Assume “one size will not fit all” and break into phases, if possible
- Follow contours if possible, especially on smaller pipelines
It’s not all “bad”

- Depending on the size of the linear project, you will likely get edge effect reinvasion of desirable species
- Seeding may actually keep out adjacent undesirables, if present prior to disturbance
Successful Pipeline Reclamation

EARLY INTERIM RECLAMATION

FINAL RECLAMATION
Words to the Wise

- Don’t ignore soils…it begins and ends with the soils
- Understand the scale of the information you have or need
- Pay attention early in the planning process
- Avoid areas that will give you problems
- Understand the economics of NOT doing the previous points
QUESTIONS??????

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