Soils handling for pipeline construction

- *Tips from the field*

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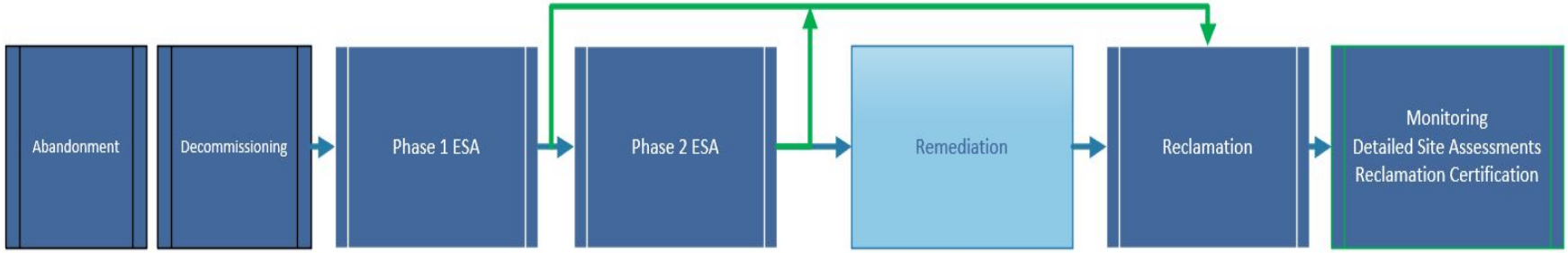
Objective

- Quick overview of the Phases of environmental work in Upstream Oil and Gas
- Tips to help you prepare and execute work in the field
  - Focus on pipeline construction
- Ask questions
- But first…
  - How many of you have jobs post graduation?

Environmental Services – Abandonment to end of life reclamation



Activity	Downhole abandonment Cut and Cap	Surface decommissioning Pipelines	Regulatory interpretation Well file records review Interviews Site visit Aerial imagery review Drilling waste calculations Decision for contamination potential	Assessment planning Regulatory interpretation Field assessment Intrusive soils investigation Report findings Recommendations	Remediation action plan Regulatory interpretation Landfill coordination Excavation of contamination Landfilling Confirmatory sampling Backfilling	Reclamation planning Regulatory interpretation Onsite equipment mgmt Soil salvage Earthworks Soils assessments Revegetation	Regulatory interpretation Vegetation monitoring Closure field assessments/ justifications Reporting Application for reclamation certificate
Skillsets	Wellhead: Fac-PL Notifications – LO/3rds Engineering in-house Welding	Wellhead: Fac-PL: in-house Engineering in-house	Member of AB/BC recognized professional organization - review file records and tour reports - determine if contamination potential exists - conduct interviews with operator and landowners - complete drilling waste calculations - acquire and interpret air imagery	Member of AB/BC recognized professional organization - Ground disturbance supervision - Technical supervision (drilling, sampling) - Reporting of field data - Determine if remediation is required - Site safety management	Member of AB/BC recognized professional organization - Ground disturbance supervision - Technical supervision (remediation, sampling) - Landfill record keeping - Site safety management	Execute reclamation objectives Arrange and manage heavy equipment onsite Arrange permitting and manage onsite safety - Ground disturbance supervision - Technical supervision (reclamation) - Site safety management	Member of BC recognized professional organization - assess site for readiness - prep site for closure - conduct soil, veg, topo assessment - closure reporting for rec cert

Begin with the end in mind

- S. Covey

Phases of a typical pipeline project where soils handling should be discussed or implemented include:

- pre-construction planning
- construction & monitoring
- clean-up & assessments

To begin with the end in mind seems intuitive unless you are not involved throughout each phase of the process

There is more than one way to get there…

And here are some of the things learned along the way

Preconstruction Planning – p/l construction (Soils, Vegetation, Landscape)

Typical reclamation issues:

- **Topsoil**
  - soil placement
    - proximity to work area & other piles,
  - improper salvage (under or over stripping)
  - erosion
  - admixing
    - loss of organic matter
- **Compaction**
  - compacted surface soils or subsoils within work area
  - subsidence – lack of compaction or voids during frozen conditions
- **Landscape/contour**
  - subsurface contour or
  - poor topsoil distribution

Preconstruction planning

Adding value in the field

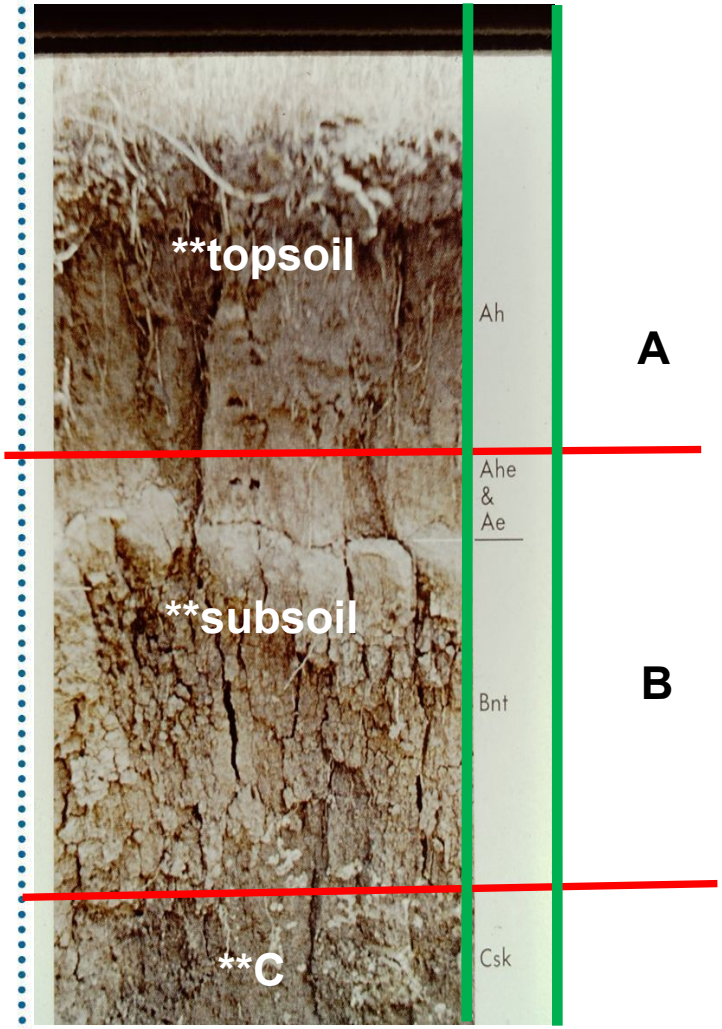
1. Understand the scope of work contract expectations for soils handling
2. Interpret a soils assessment to anticipate soils types, soils handling approaches and possible challenges
    a) For the landowner
    b) For the equipment operator
    c) Related to the types of equipment working on the ROW
3. Plan for soil storage locations and strategic breaks for soil conservation, separation, drainage and field access
4. Plan to observe soils handling by the operators and make corrections to prevent soil degradation/losses or other handling issues
5. Plan for erosion and sediment control measures during and post-construction

Understand the project contract

- Potential exists for cause confusion between the pipeline company and the inspector if expectations are not aligned
  - Scope of work (SOW)
  - Environmental Protection Plan
  - Schedule A (pre-disturbance assessment)
  - Inspector interpretation

Prepare to interpret soils assessments

What the assessment says v. what the field sees



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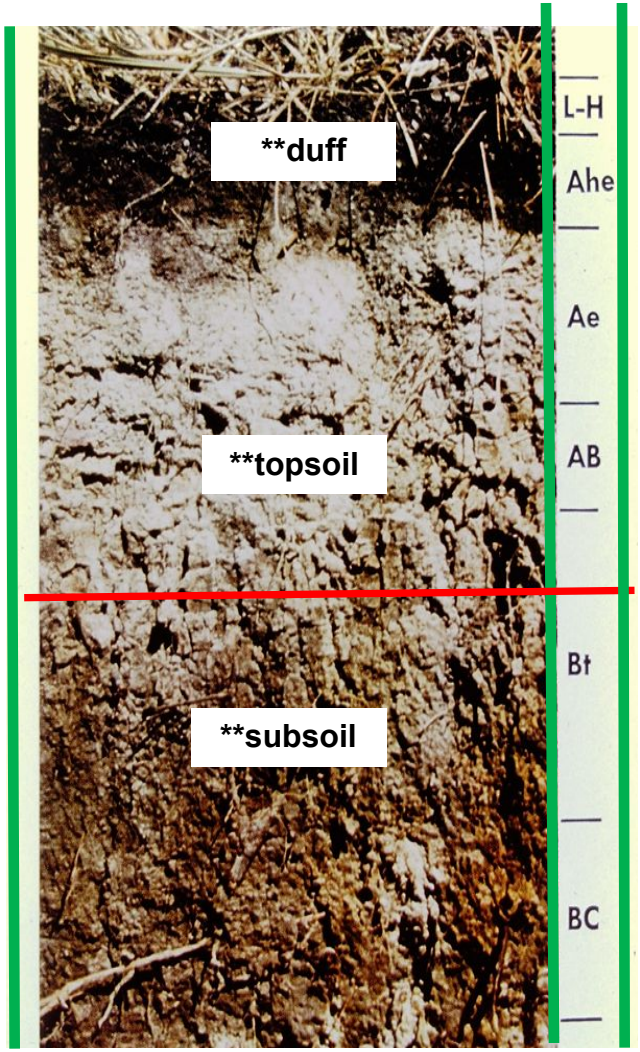

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Soils handling – Simplify the field guidance

SAMPLE #: PL1							CREW:		DATE:		PROJECT:	
Colour Change		Surface Expression		Aspect		Slope Class	Slope Position		Surface Drainage		Surficial Stoniness Class	
Good		UND		N		2: 0.5 - 2%	M		M		S0	
Profile	Depth (cm)	Texture	Colour	Mottling			Soil Structure			Consistence	Rocks	
				Abun.	Size	Contrast	Grade	Class	Kind	D-M-W	Cons	%	Kind
Ap	0-11	CL	10YR2/2	-	-	-	W	F	GR	W	SLS	-	-
Btgj	11-29	C	10YR5/2	C	M	D	M	F	SBK	W	SLS	-	-
BCgj	29-61	C	10YR4/1	C	M	D	W	F	SBK	M	F	1	PE
Ck	61+	C	10YR3/1	-	-	-	-	-	MA	M	F	2	PE
Land Use				A Horizon (cm)						Pre-disturbance Soil Texture			
Cultivated Cropland				11						Clay Loam			
Vegetation:		Canola											

Soils person

Equipment operator

Sample Point	Surface Organic Layer (cm)	A Horizon (cm)	Topsoil Depth & Stripping Recommendations For Operators & Inspectors		
			Total Stripping Depth (cm)	Colour Change	Recommendations
TW1	-	20	20	Good	Strip to Colour Change T: Very Dark Gray S: Light Brownish Gray
PL1	-	11	11	Good	Strip to Colour Change T: Very Dark Brown S: Grayish Brown

Preconstruction planning
Why plan for soil storage?

Plan for soil placement to prevent topsoil loss

If this is not avoided or caught early enough, additional reclamation costs begin at $2500/m

We begin to cover this expectation in the Pipeline RFP Scope of Work contract

Construction - Having the right people in the field

Before handling soils…

- Any landowner concerns?
- Do you have the right equipment onsite?
  - A large dozer or grader is not always the right tool for stripping topsoil
- Is the equipment in good condition?
- How skilled are the operators/supervisor?
- Are you working outside of your subject matter expertise?

Plan ahead… minimize topsoil handling

Monitoring – during/post- construction

Summer build (what to look for in summer and fall)

- Encountering a spring during construction
- Erosion and sedimentation
- Weeds
- Soil moisture
- Revegetation

Winter build (what to look for in winter and spring)

- Encountering a spring during construction
- Erosion and sedimentation during spring
- Trench compaction, subsidence spring to summer
- Soil saturation/ snow under or over soil
- Trench stability
- Pipe security – heaving during breakup or mud-jacking during compaction

ROW soil handling - 101

<u>The process is simple…but the path here was long</u>

1. **Salvage all topsoil**. If required, salvage B horizon (3-lift).
   - Avoid admixing - This can be accomplished with a transition layer (the transition is a discretionary call)

   a. **Manage for erosion and sedimentation** until clean-up

2. **Excavate**… Pipe in the ground… **Compact the trench**
3. **Assess subsoil compaction** before final recontour
4. **Recontour ROW** subsoil to adjacent subsoil grade
5. **Evenly redistribute all topsoil**

   a. **Prepare the seedbed**

- 2 lift

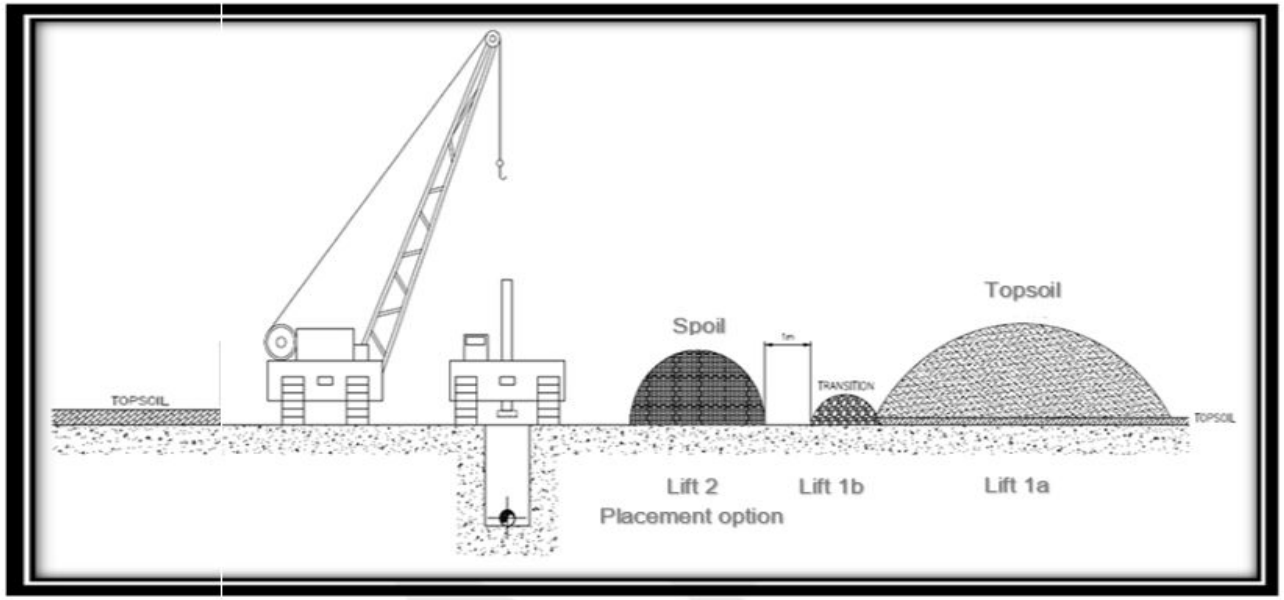


Figure 3a (above) illustrates an example of equipment and soil placement during modified **two-lift full-strip with a topsoil transition**, single line RoW construction. RoW dimensions may increase or decrease depending on construction timing and workspace requirements.

Landowners ask:

Where do you place the soil and why are ROW's so wide?

- 3 lift

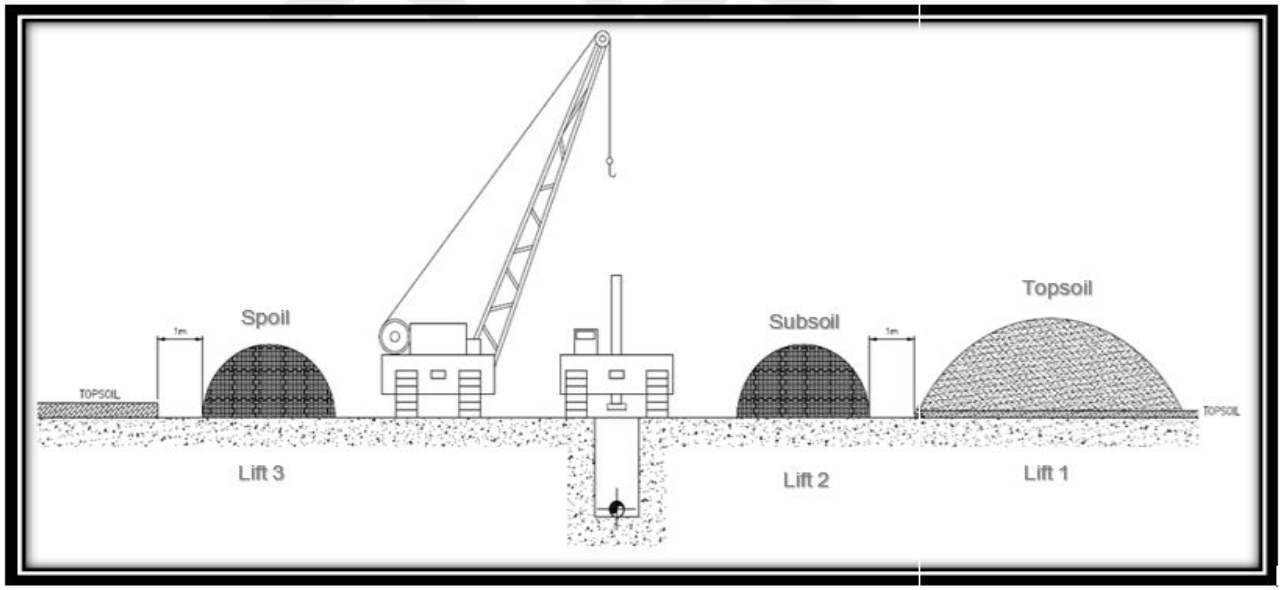
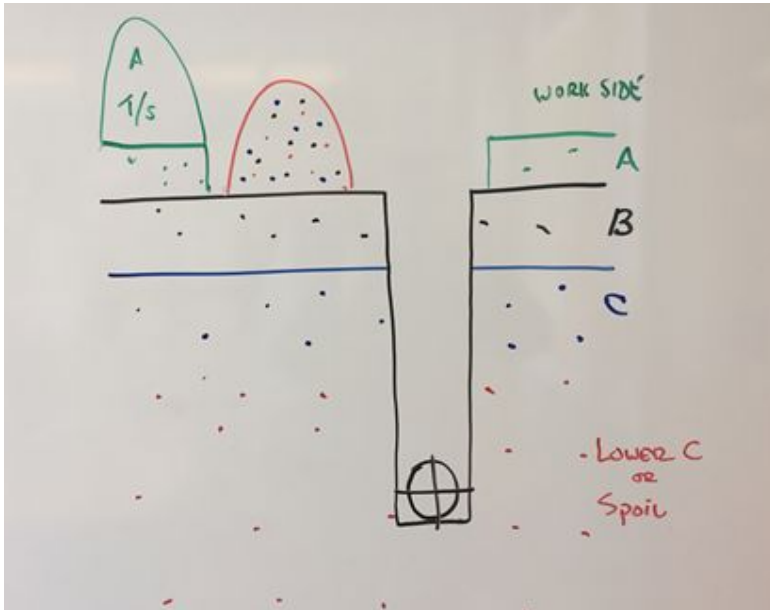
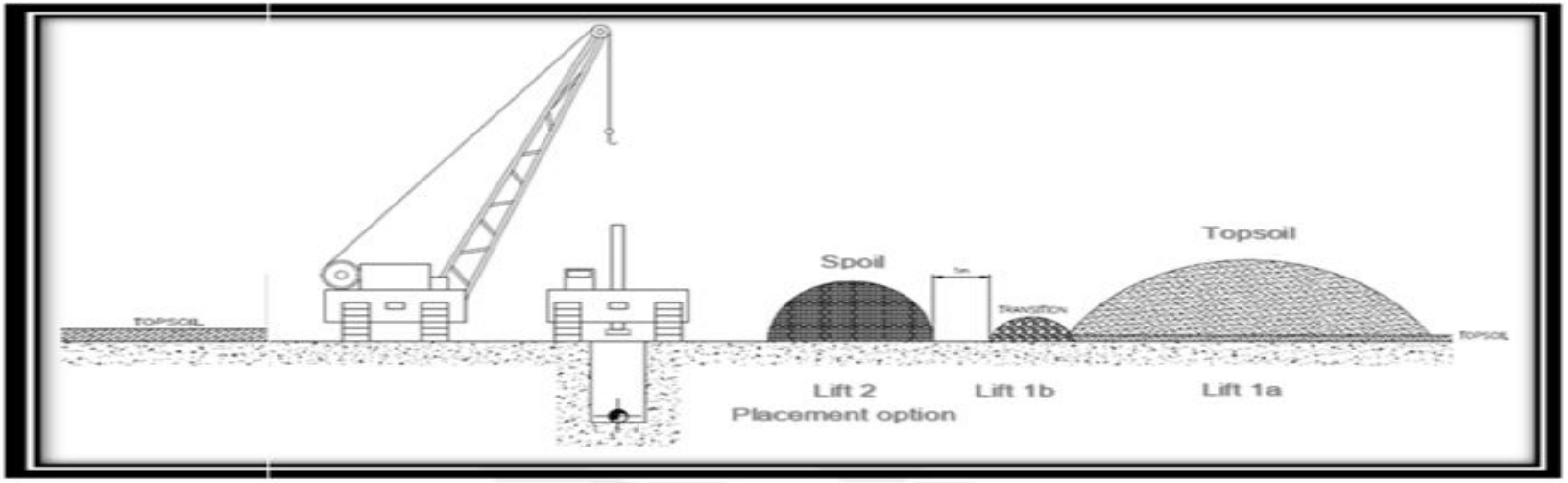


Figure 3b (above) illustrates an example of equipment and soil placement during **three-lift full-strip**, single line RoW construction. RoW dimensions may increase or decrease depending on construction timing and workspace requirements.

2 Lift build – Soil Profile (& compaction areas)

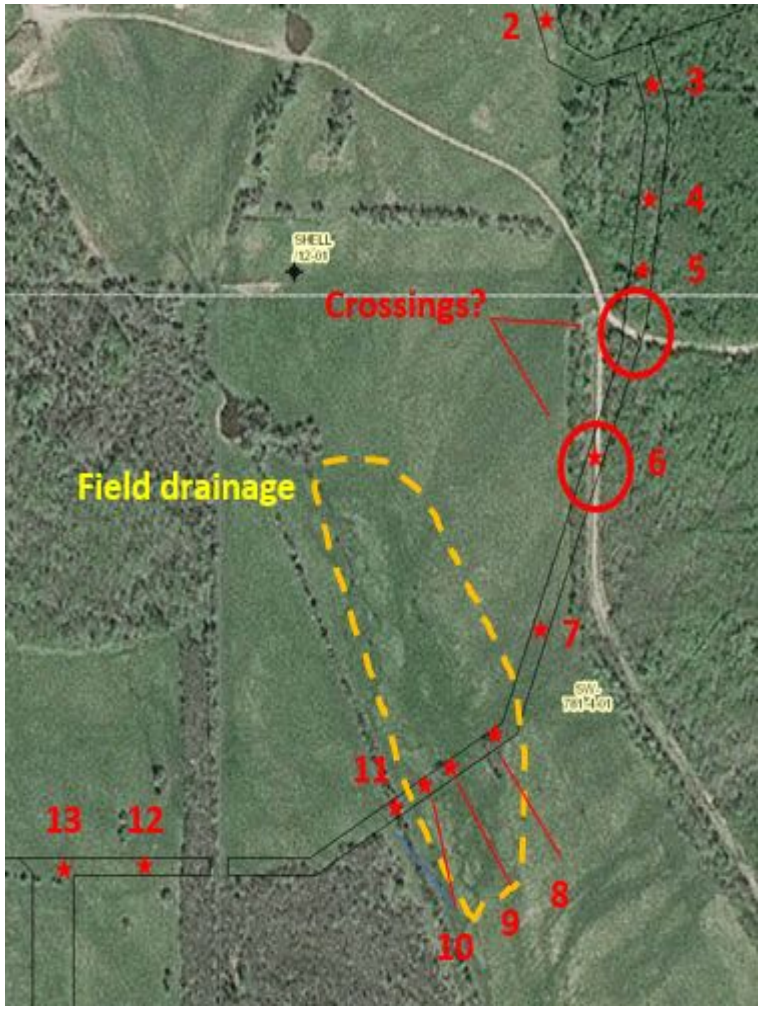




Planning – ESC considerations

When considering which erosion or sediment control (ESC) measure to use, we ask:

- Where are the areas of potential concern?
  - Is a site-specific erosion/sediment control plan required?
- Will the contractor installing the ESC measures qualified?
- Do landowner farming practice present any erosion control limitations, issues, or considerations? (i.e., Seeding orientation, conventional tillage, etc.)



Erosion Happens

Problems do not exist only in industry. Landowners also experience erosion.

However, the expected standard of repair quality for industry is much higher that a landowner fix

Erosion happens

Water followed a seemingly minor depression within the RoW.

On zero-till farming operations, there is no free reclamation

Surface Water Erosion – no measures

Disturbing soils and removing vegetation cover increases erosion potential

2011 – Seemingly minor at first

$190,000 in reclamation costs for 1600m

Qualified installation is critical

Silt fences/bales - not suitable to break energy of concentrated flows

Wattles and low-rise measures - break energy of concentrated flows and allow excess to flow over

Examples of erosion control measures – properly installed

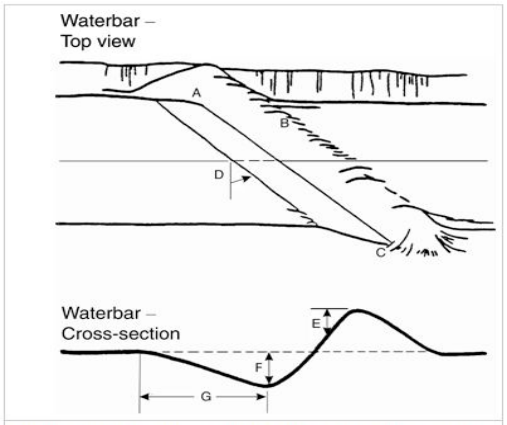
Sediment log (large & tightly packed)
Wattle (smaller and loosely packed)

Spring berms

Erosion blankets/ coco-matting

Tackifier/ hydromulch/ hydroseed

Silt fence/ filter cloth



Waterbar/ bar ditch

Plan for Erosion & Sediment Control

Spring inspection of ESC measures installed fall.

- Crimped straw
- Wattles
- Coco-matting
- Conserves soil moisture
- Reduces surface soil erosion
- Requires Nitrogen application to help break down straw
- Retains soil moisture

Qualified installation pays dividends

Plan for spring surface water and ESC inspection

Jumping ahead for a sec - Compaction

If not addressed during construction, soil compaction can lead to decreased plant growth and/or early maturation

2007 - Before decompaction measures

2010 - After decompaction measures

Learning: Decompaction prior to topsoil replacement was missed.

Compaction - indicators

Soil compaction can lead to:

- poor root penetration,
- changes in soil structure and consistence

Before replacing salvaged topsoil

Has the trench spoil been adequately compacted?

Has the subsoil receiving the topsoil been assessed for compaction and properly graded?

- decompaction prepares the subsoil rootzone
  - This process leaves breaks up hard soils, homogenizes residual spoil and subsoil, and leaves uneven surfaces
- uneven surfaces increase potential for
  - admixing
  - topsoil losses
  - landscape issues (drainage, farmability…)

These issues are not new, but there is no free reclamation and deficiencies are not being masked post reclamation

Admixing/ uneven subsoil

shallow depth of topsoil is replaced over uneven subsoil

Roaching

Roached trenches – improper backfilling? – winter construction?

Is the plan to return in spring to finish the job? Coming back to fix things costs money

Settling - Subsidence

Soil instability – subsidence within the trench

Cleanup - Subgrade to do list (pre-topsoil)

Assess RoW root-zone compaction

Re-establish the pre-disturbance grade across the ROW

- Re-establish pre-disturbance drainage patterns in contour

Confirm the absence of subsidence, roaches, tension cracks, dishes and ridges on the trench and ROW prior to topsoil replacement

Final subgrade before topsoil replacement

RoW is ripped and/or disked to decompact

Key-in edge of disturbed area so topsoil replacement depths can be consistantly met

Rotospiking/power-harrowing is not always required.

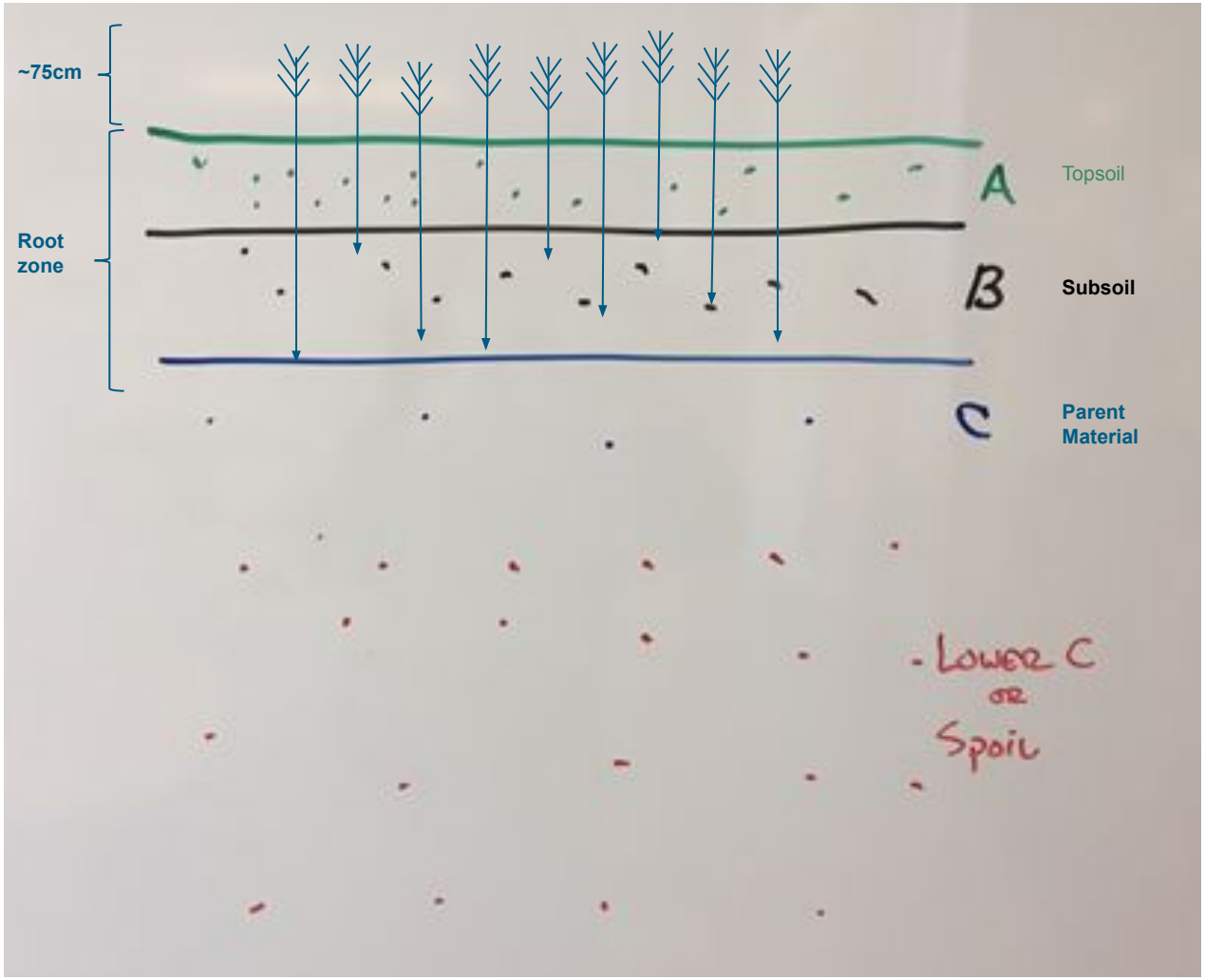
Topsoil replacement – Seedbed prep

Redistribute the topsoil to re-establish original grade both across and down the ROW.

Assessments: Identify – Assess – Manage

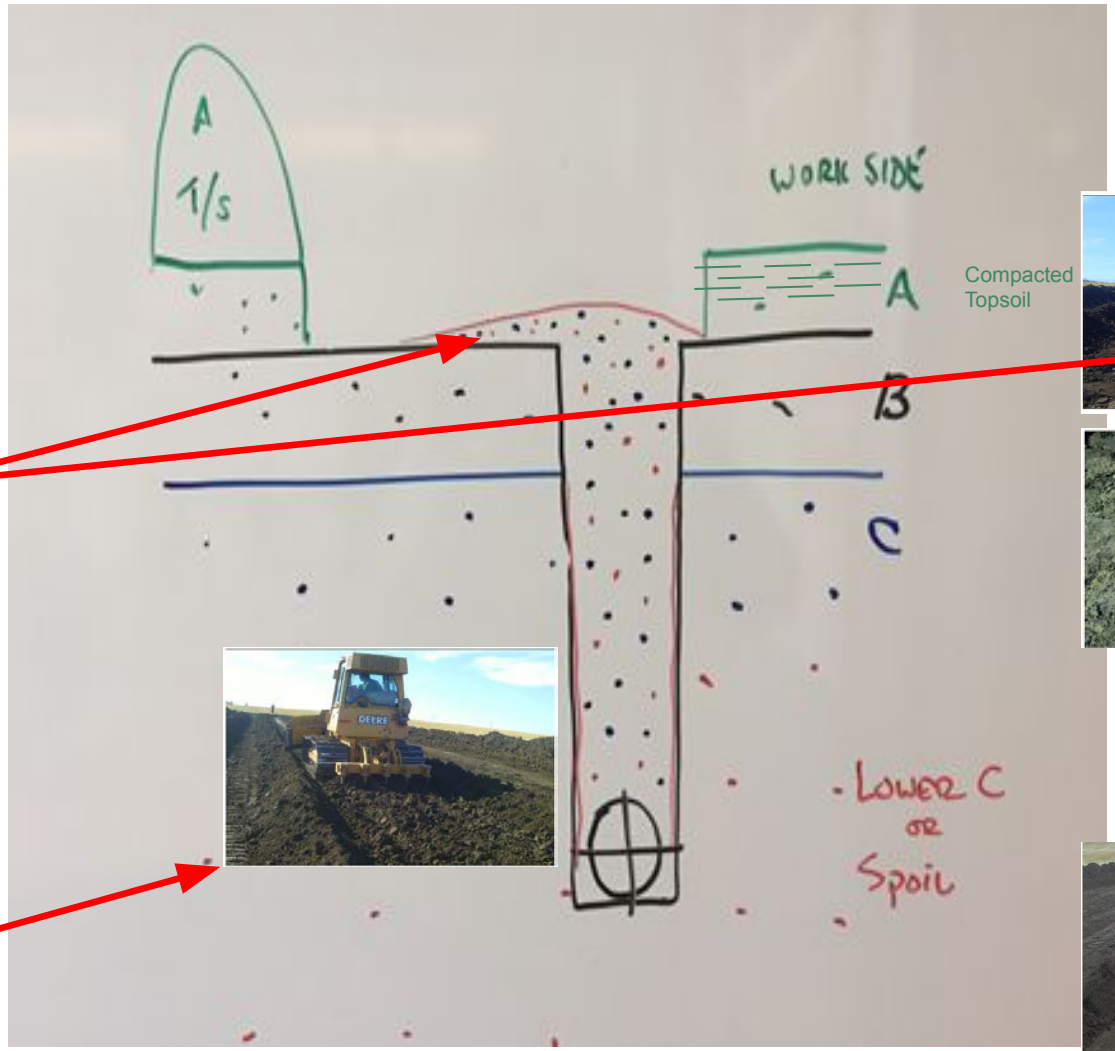
Pipe in the ground and equipment offsite… how are things at and below surface?

Assessments: Soil Profile (control)



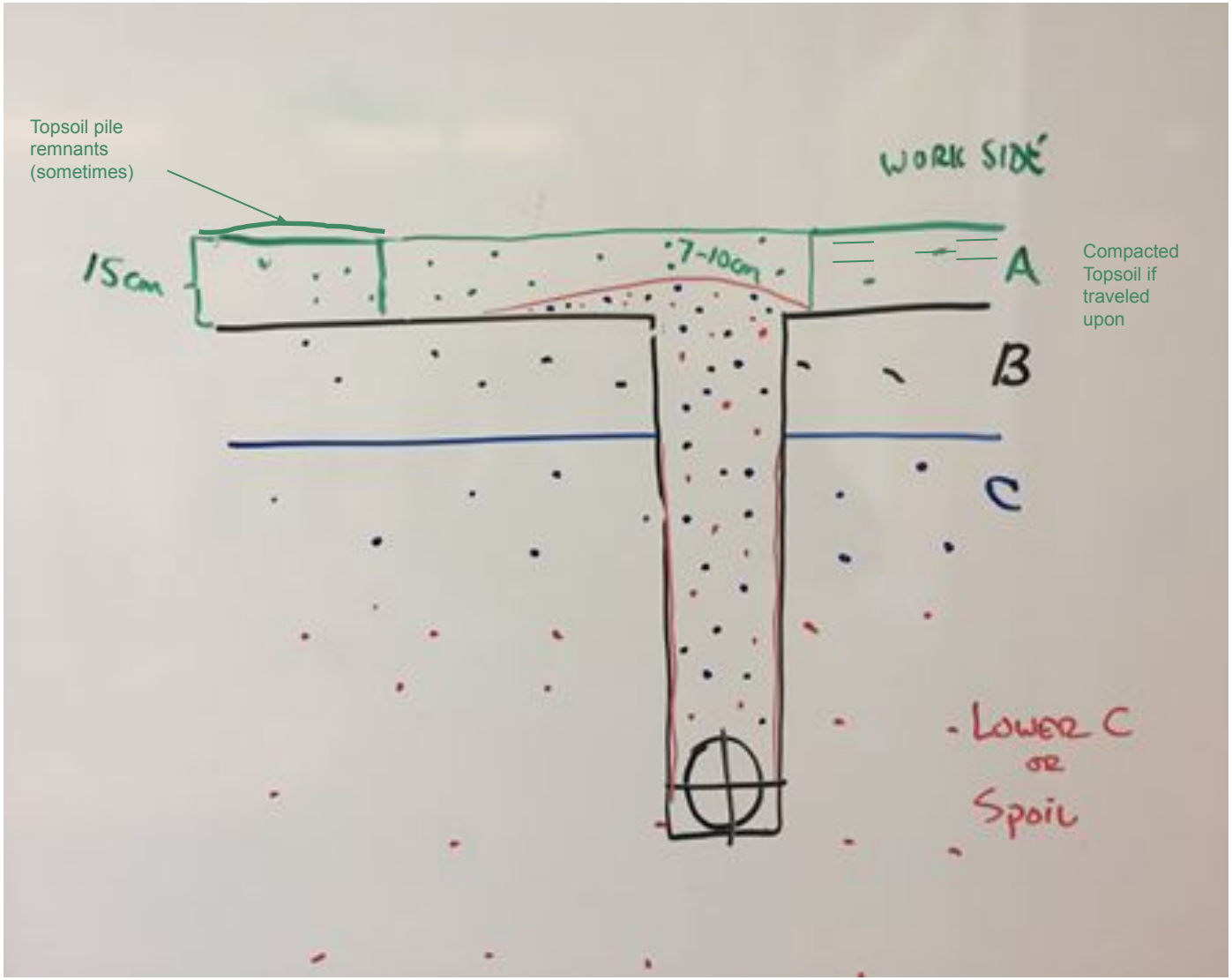
Assessments: Understand backfilling

- With pipe displacement and air pore space, all material may not go back in the trench.
- Contractors may want to feather excess material
- this is not acceptable in the updated PL SOW
- We expect them to decompact and regrade

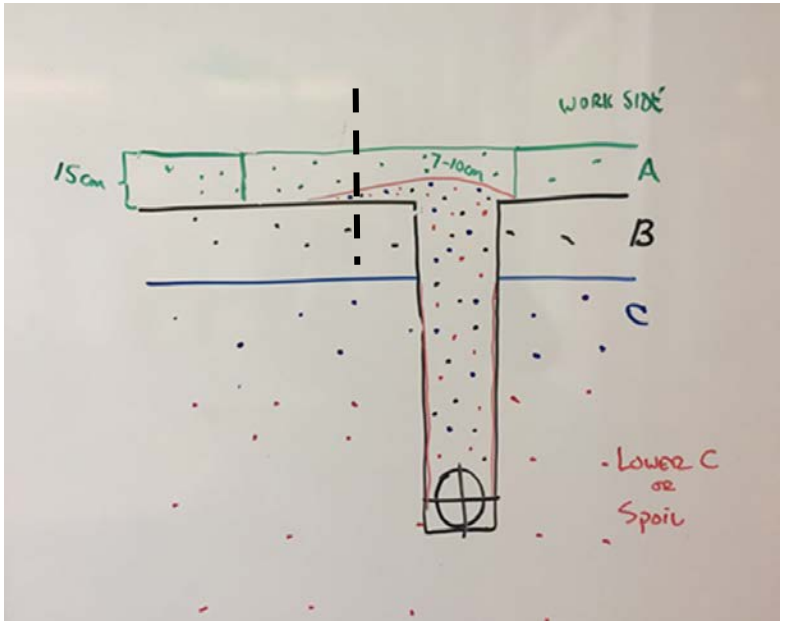


Compacted Topsoil

Assessments: Topsoil replaced w/ roach, without subsoil decompaction and base grading



If so… during the soil assessment, we see this:



So what?

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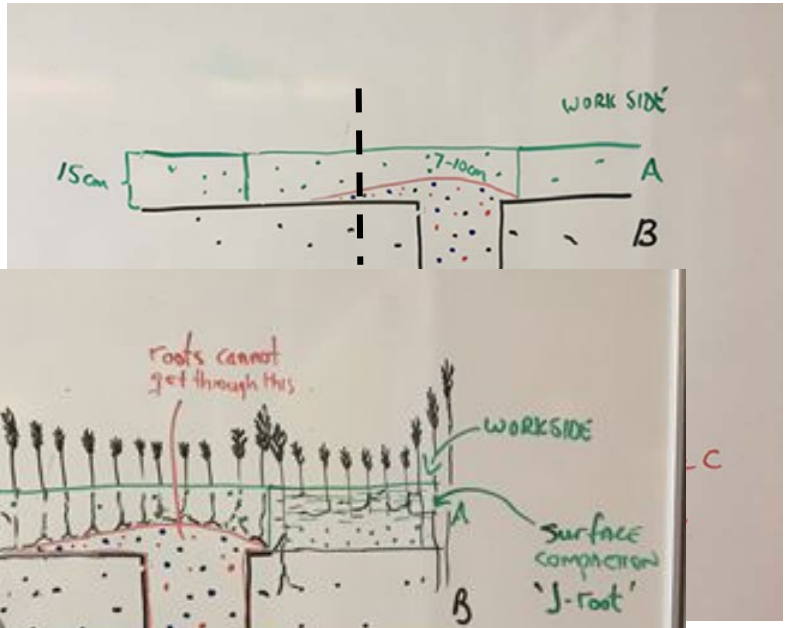

So what?

Crop response

In the end, it is repairable… but at what cost?

QUESTIONS?


WHEN YOU'RE AT A PARTY
AND NO ONE WANTS TO TALK ABOUT SOIL HEALTH
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