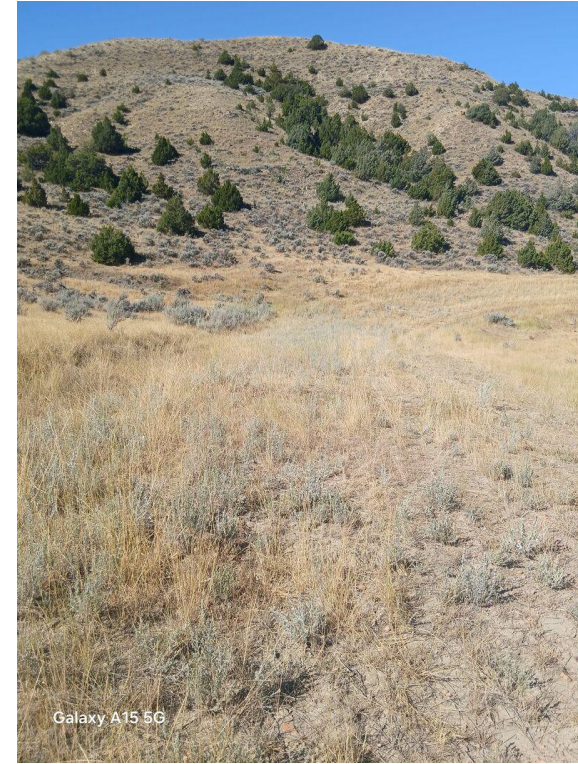
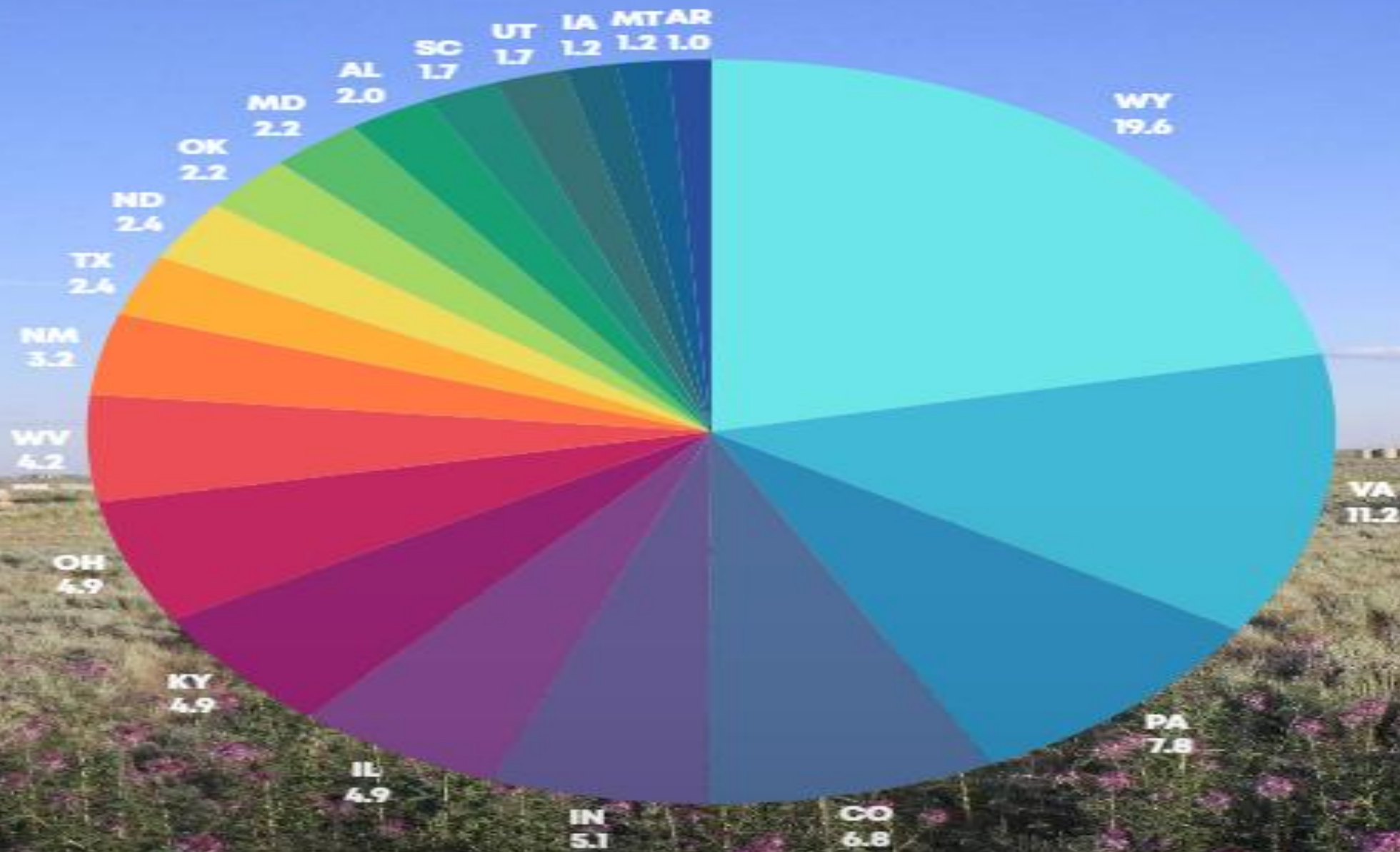


# Lessons Learned from Over 400 Years of Practical Experience



Michael Curran, PhD, CWB  
Abnova Ecological Solutions  
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**Wyoming: A Leader  
in Reclamation**

# Brief History

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- Bob Budd (WWNRT) reached out to several agencies and industry members after November 8, 2022 SGIT
  - Petroleum Association of Wyoming
  - Wyoming Department of Environmental Quality (AML)
  - Wyoming Game and Fish Department
  - Wyoming Mining Association
  - Wyoming Oil and Gas Conservation Commission
  - Bureau of Land Management
  - Audubon Society
  - Carbon County
  - Thunder Basin Grasslands Prairie Ecosystem Association
- Group met on-line November 22, 2022
- In person meeting November 30, 2022 (Petroleum Association of Wyoming Wildlife and Reclamation Conference)
- In 2023-2024, 10 white papers (>187 years experience) received from WMA, PAW, WYDOT
- In 2024-2025, 16 survey respondents (>200 years experience) – BLM, WGFD, WYDEQ, WMA, PAW, WYDOT, Consultants/Contractors \*\*All 23 Counties Represented

# Goals of this Project

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- What is this group hoping to accomplish?
  - Summarize what we know about revegetation/reclamation/restoration in Wyoming
  - Share information to avoid future failures, increase chances for successful outcomes
  - Guide to assess best areas to invest in restoration and reclamation across the State
    - Reclamation – regulated activity
    - Restoration – non-regulated activity
- What isn't this group aimed at accomplishing?
  - Changing policy
  - Isolating any given industry
- Expanding from existing contributors
- Avoid re-inventing the wheel

# Sage advise from Jim Truax

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What advice would you say to new folks entering the field of reclamation?

“Review prior reclamation work in the field before starting out so you don’t reinvent the wheel. Do an historical review of past efforts.”

Would you do anything different in your life regarding your career?

“I would get more education early. My education came from try-fail-try-fail. I did not do adequate research on what had been done before.”

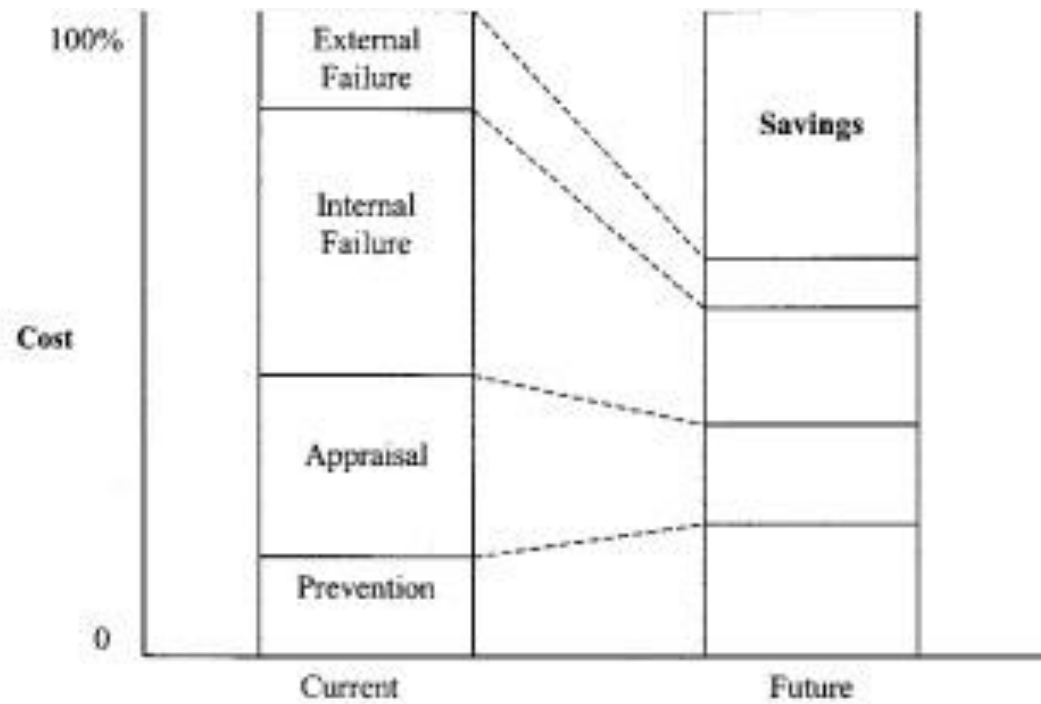
# Commonalities

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- Identifying limitations and setting goals
  - Reference system/Benchmarks
- Soil handling and management
  - Segregation of suitable material and overburden
  - Avoiding compaction at both subsurface and surface
  - Seed bed preparation
- Seed timing
- Seed rates
- Seed quality
- Weed control
- Monitoring and Adaptive Management



# Causes and Costs of Rework in Construction (Love & Li 2000)



# Application to Reclamation

Tarnished Relationships/Reputation • Future Permitting Issues • Compliance Fines • Hiring New Contractor • Increased Destruction to Surrounding Landscape

Regrading Site • Reseeding Site • Recovering Sediment • Reapplying Soil Amendment • Reapplying Erosion Control Measures • Herbicide Spraying • Other Rework

Monitoring • Reporting

Proper Soil Handling and Management • Restoration Planning • Seed Mix Specification/Acquisition • Seed Bed Preparation • Careful Installation



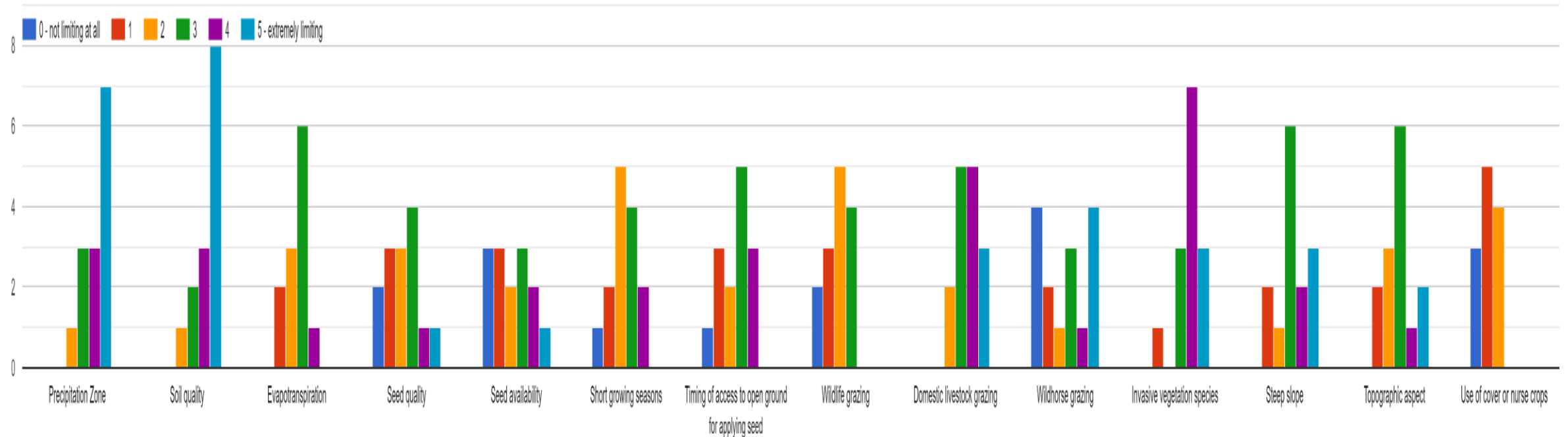
# Technical Bulletin

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- Introduction plus 10 sections:
  - Understanding Limiting Factors and Goal Setting
  - Pre-disturbance Site Characteristics and Reclamation Planning
  - Soil Handling & Management
  - Revegetation
  - Weed Management
  - Grazing
  - Natural Events
  - Monitoring and Adaptive Management
  - Regional Experts and Contact Information
  - Appendices

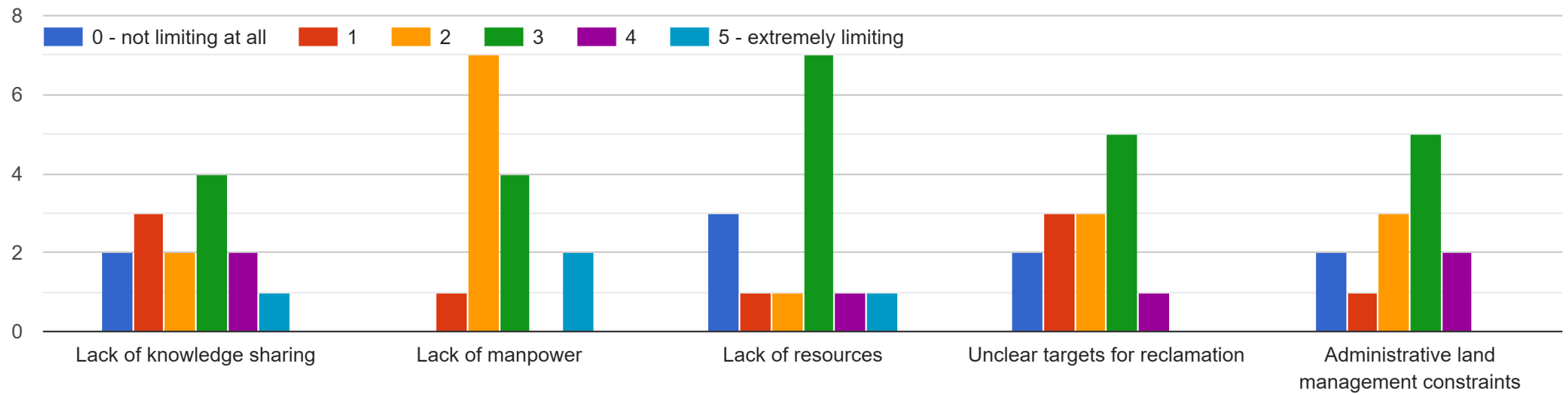
# Limiting Environmental Factors

Please rate the following environmental factors which may limit reclamation potential in the area where you work from 0 to 5, with 0 being not limiting at all and 5 being extremely limiting:



# Limiting Social Factors

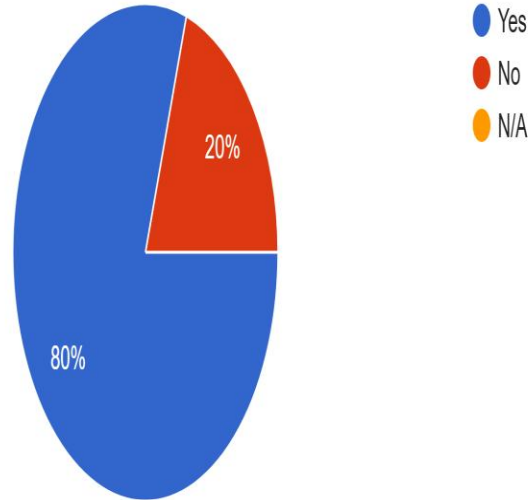
Please rank the following non-environmental factors which may limit reclamation success in the area where you work from 0 to 5, with 0 being not limiting at all and 5 being extremely limiting.



# Pre-disturbance Testing

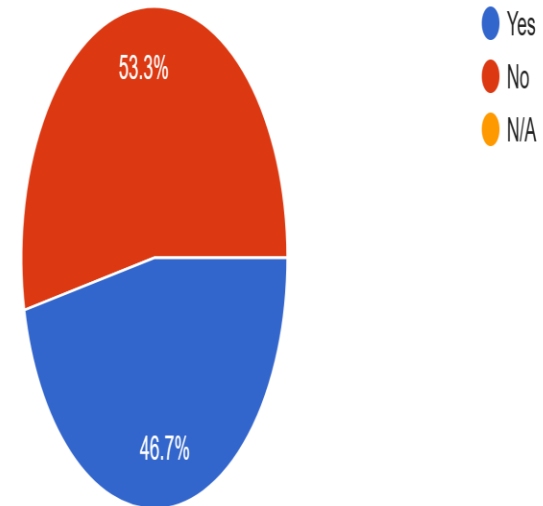
Do you find vegetation surveys to be useful prior to disturbance?

15 responses



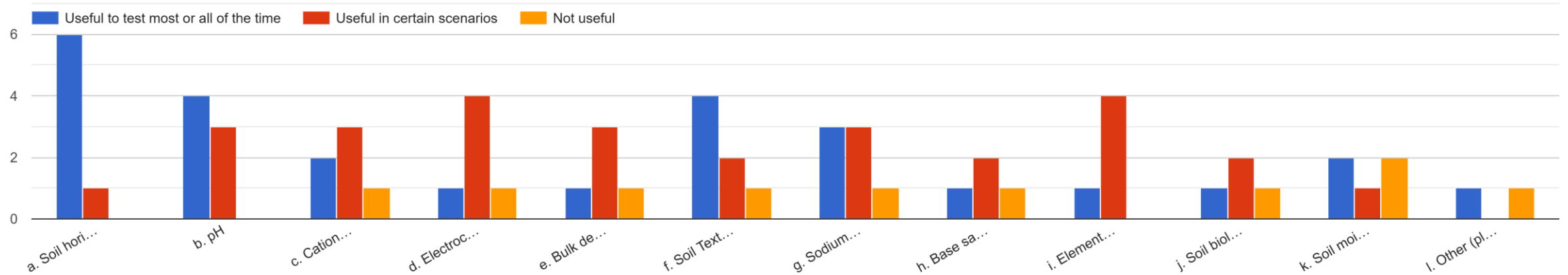
Do you find it important to the success of your reclamation program to test soil before site reclamation?

15 responses



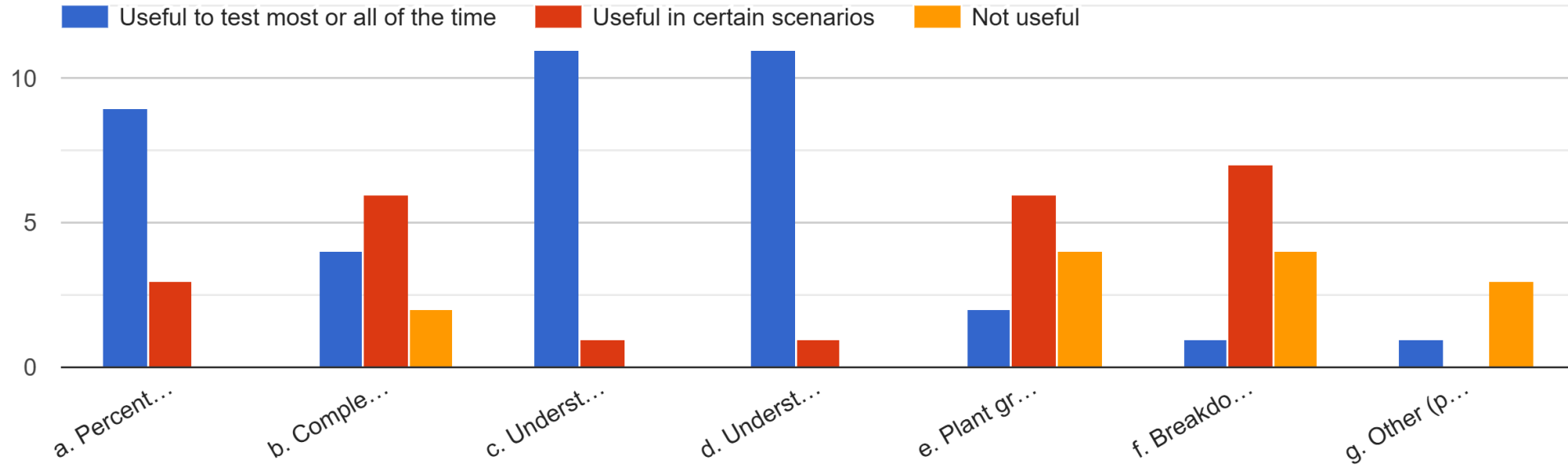
# Soil parameters

Please indicate which of the following parameters are 'useful to test most or all of the time', which are 'useful in certain scenarios', and which are 'not useful' for you to check to assist with decision making for reclamation.



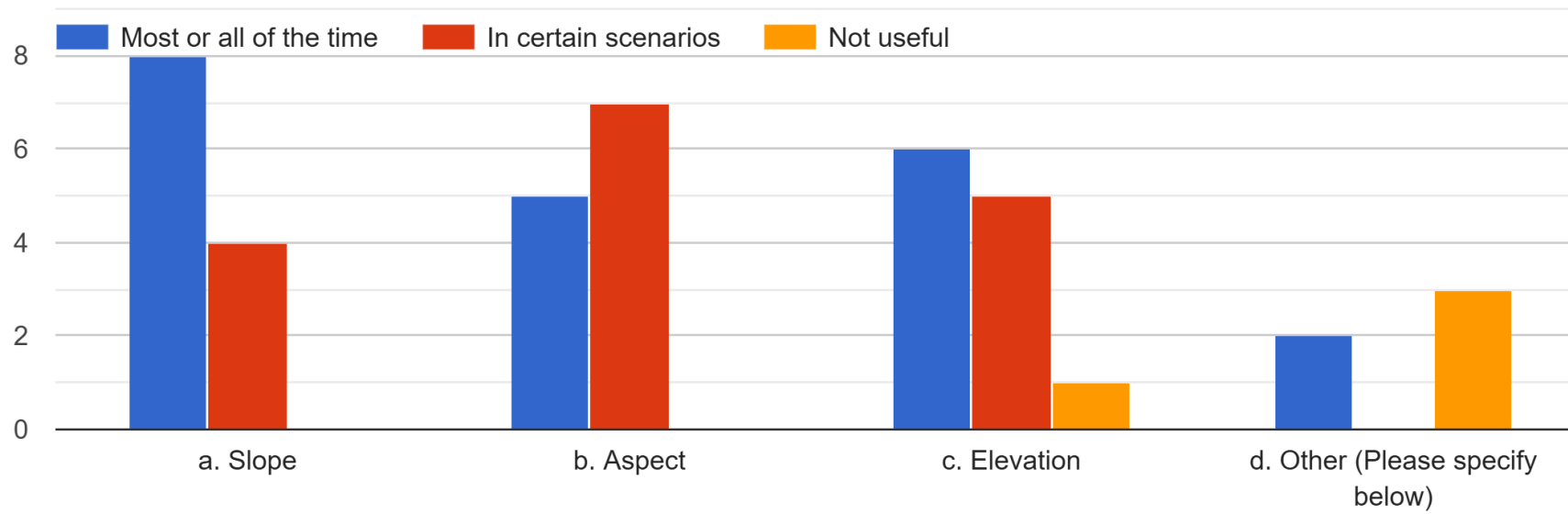
# Vegetation parameters

Please indicate which of the following parameters are 'useful to test most or all of the time', which are 'useful in certain scenarios', and which are 'not useful' for you to check to assist with decision making for reclamation.



# Geographic parameters

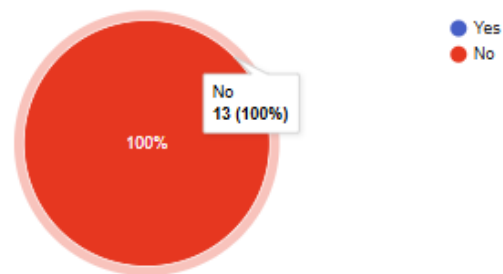
Please indicate if you find any of the following geographic factors useful to gather information on prior to disturbance 'most or all of the time', 'in certain scenarios', and which 'not useful'.



1. Is there a uniform depth within the area you work at which you strip topsoil?

[Copy chart](#)

13 responses



If you answered **YES** to question 1:  
What is the depth?

1 response

Stripping topsoil is not applicable to the types of work I do.

If you answered **NO** to question 1:

Please describe methods used to determine the appropriate depth. Please describe the range of depths you may find in the area which you work.

11 responses

This should be able to be done by an experienced machine operator

strip a test section to see the depth of topsoil. monitor and adjust as you do along for the rest of the stripping

Soil profile analysis and testing

Not germane to my past restoration work

Visual via test pits

Range of depths is 3 inches to 8 inches

We do pre-mine soil sampling to determine salvage depths of top and sub soils.

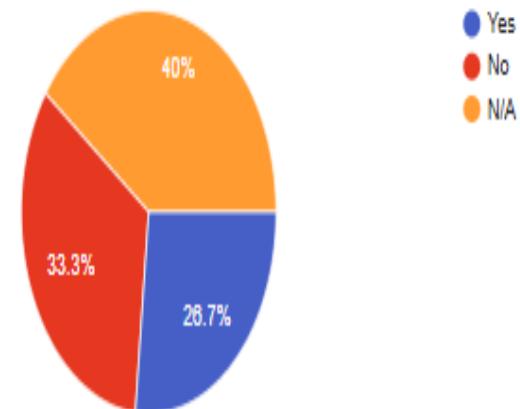
Pre-mine soil survey that is translated onto ground breaking work. 0'-30+'

I usually rely on soil pit or chemical reaction tests.

2. Do you find it necessary to segregate all soil horizons during the topsoil stripping phase?

[Copy chart](#)

15 responses



## Soil Handling and Management - Soil Segregation & Stripping (Part 2)

1. What are the typical number of horizons you segregate and why do you segregate horizons?

4 responses

2

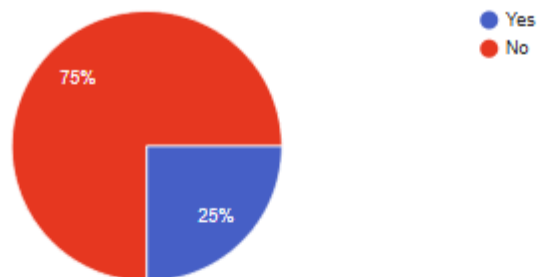
two; topsoil and subsoil

3-4, to determine the soil types at each depth

## 2. Is material underneath topsoil segregated?

[Copy chart](#)

4 responses



If you answered **YES** to question 2:

Please describe types of material which may be segregated (e.g., suitable subsoil, spoil/overburden) and how you distinguish between these.

1 response

On occasion 3rd material is salvaged in some situations. Usually we determine that during pre-mine studies or coloration and root presence in the field.

### Soil Handling and Management - Soil Segregation & Stripping (Part 3)

Please provide other comments related to soil segregation and stripping and their influence on reclamation outcomes as you see fit.

4 responses

Probably the most important factor on reclamation success or failure. Ideally, limit salvage during good conditions, not muddy or frozen

Not necessarily soil horizons. More of similar suitability

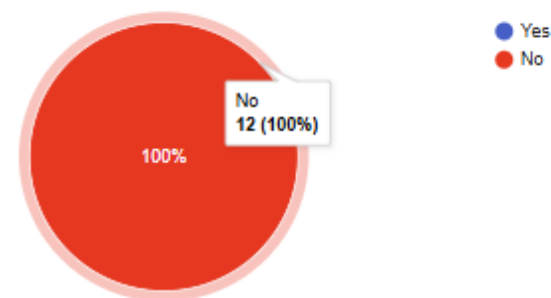
Very important not to mix suitable soils with non-suitable into different piles.

combining soil survey and soil salvage plan with good communication with the equipment operator is really helpful

## 1. Is there a standard height at which you store your soil stockpiles?

[Copy chart](#)

12 responses



1a. If **yes** to question 1, what is that height?

0 responses

No responses yet for this question.

1b. If **no** to question 1, please describe factors which may cause storage height to vary.

10 responses

Size of disturbance and total soil volume

slope, topography, amount of material, etc.

1. Disturbance area in relation to the amount of material needed to be stored.
2. Amount of time material is planned to stored and stockpiled.

No experience with storing soil stockpiles/ reclamation work very limited

Research shows topsoil stockpile height is not detrimental to the topsoil

Generally, try to limit piles and don't want increase disturbance footprint by excessive piling

Limited approved disturbance space

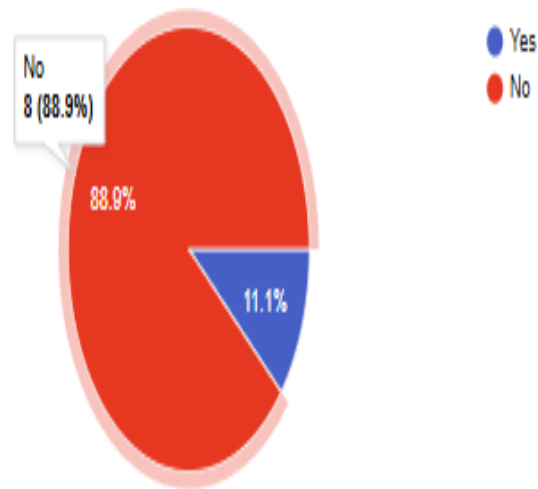
Usually amount of topsoil and room to store.

available space and topsoil volume

2. Have you found topsoil fertility to be impacted by storing stockpiles over a certain height?

[Copy chart](#)

9 responses



2a. If **yes** to question 2, what is that threshold?

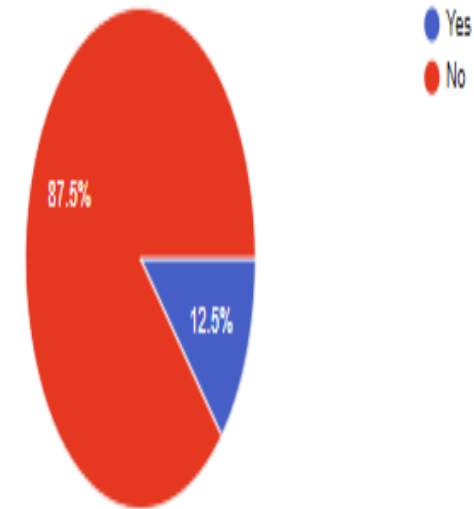
1 response

Data would indicate that topsoil storage does affect soil quality. Unfortunately our division hasn't measured pre & post storage soil quality, but have plans to on certain high priority projects.

3. Have you found topsoil fertility to be impacted by storing stockpiles for longer than a certain duration?

[Copy chart](#)

8 responses



3a. If **yes** to question 3, what is the age of being in a stockpile at which you have found topsoil fertility to become diminished?

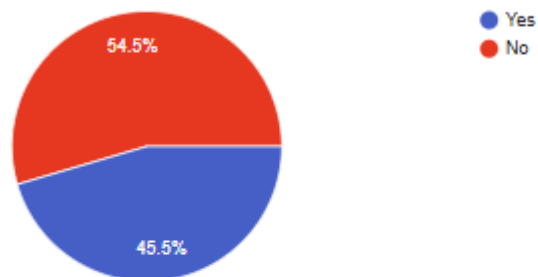
1 response

over 1 year

4. Have you utilized 'direct haul' of topsoil rather than stockpiling?

 Copy chart

11 responses



4a. If **yes** to question 4, have you noticed any benefits to direct haul – please explain.

4 responses

it is cheaper to only move the material once and not having to stockpile and stabilize the pile

Yes, native seed bank seems to be still viable and aids in successional vegetation establishment.

Yes, we will often see decent reveg, including shrubs in some areas

Live seed bank. Fresh microbes. No compaction.

4b. If **yes** to question 4, have you noticed any negative consequences of direct haul – please explain.

4 responses

It does not work in all scenarios and you need a place requiring topsoil placement nearby

Poor soil can sometimes be placed on the surface leading for the need for rework.

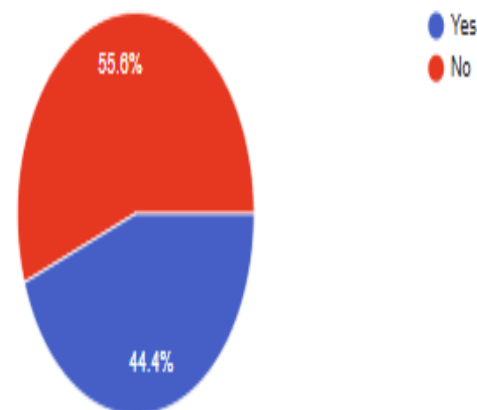
Sometimes salvage during frozen conditions isn't ideal, especially if the soil is chunky. It takes a while to mellow out and creates issues for seed bed.

fresh seed bank of Downy Brome.

5. Is there a standard slope to the sides of your topsoil stockpiles?

 Copy chart

9 responses



5a. If **yes** to question 5, what is that slope? Please explain why this is important.

4 responses

Usually defined by what equipment is proposed to be utilized for topsoil placement, with regards to safe handling of material with the proposed equipment.

If stored for more than a season, then less steep than 2:1

1.5:1. Reduce erosion potential

shallow enough slope so you can get a skid steer or tractor drill seeder on it safely. typically 2.5 to 3:1 or shallower

# Conclusions



Very large repository of information from expert practitioners



Discussions ongoing about where to store information



Soon to be disseminated as a technical bulletin



White papers and survey responses still encouraged – live updates

# Thank you!



- State of Wyoming
  - SGIT and Sage-grouse Local Working Groups
- WYDEQ, WGFD, BLM, PAW, WMA, WOGCC, WWNRT
- White paper contributors and Survey Respondents

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