take a closer look

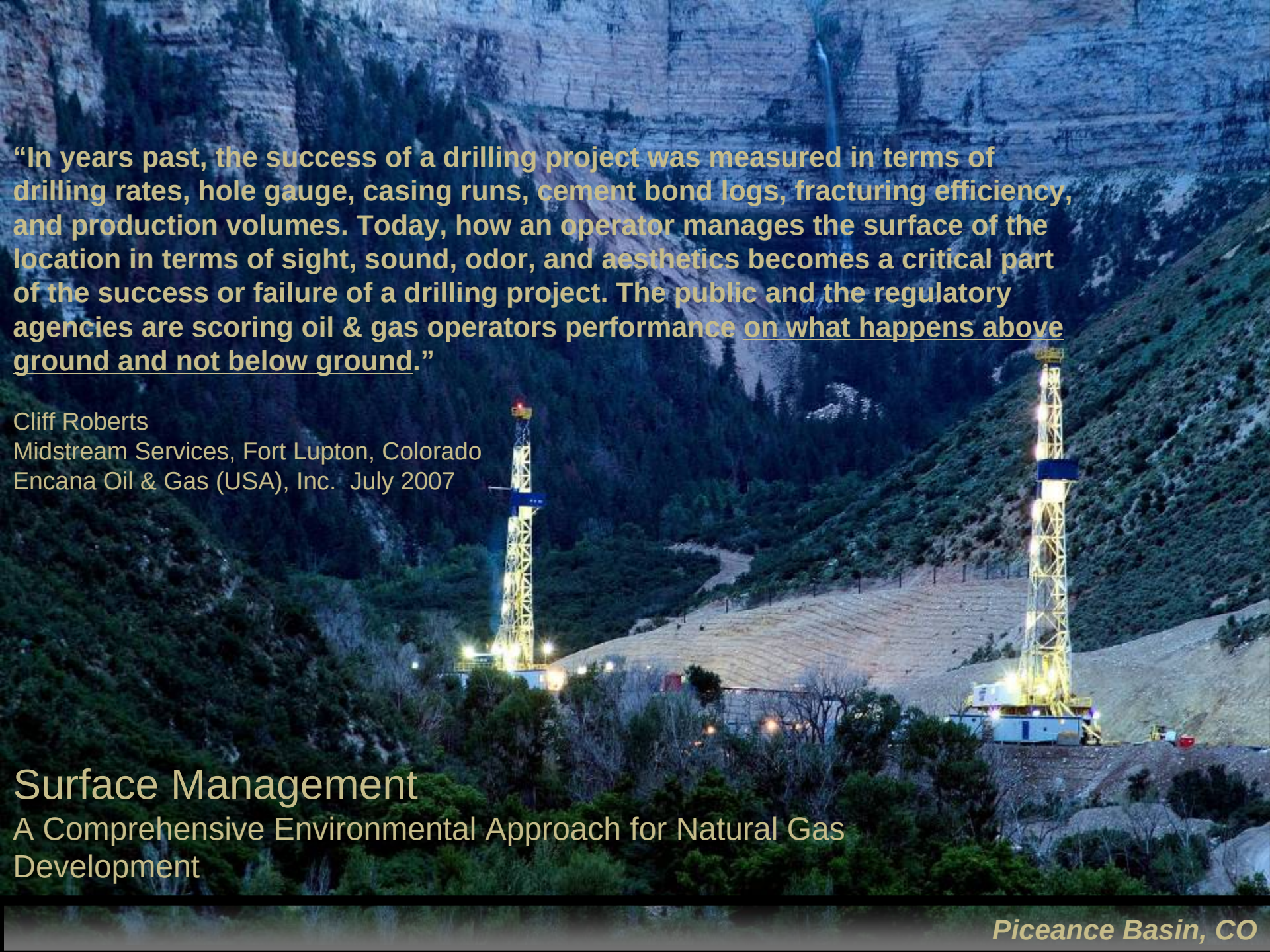
Surface Management

Garfield County Energy Advisory Board Meeting

Bryan Whiteley, L.A. | Construction & Reclamation Coordinator

Rifle Branch Library | June 7 | 2012 |

encana natural gas



"In years past, the success of a drilling project was measured in terms of drilling rates, hole gauge, casing runs, cement bond logs, fracturing efficiency, and production volumes. Today, how an operator manages the surface of the location in terms of sight, sound, odor, and aesthetics becomes a critical part of the success or failure of a drilling project. The public and the regulatory agencies are scoring oil & gas operators performance on what happens above ground and not below ground."

Cliff Roberts
Midstream Services, Fort Lupton, Colorado
Encana Oil & Gas (USA), Inc. July 2007

Surface Management

A Comprehensive Environmental Approach for Natural Gas Development

Piceance Basin, CO

Regulatory Authorities
Rules and Regulations

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- **I. Colorado Oil and Gas Conservation Commission (COGCC)**
  - Jurisdiction - CO State O&G Activities
- **II. Bureau of Land Management (BLM)**
  - Jurisdiction – BLM Federal Land
- **III. US Forest Service (USFS)**
  - Jurisdiction - US Forest Service Land
- **IV. Colorado Division of Wildlife (CDOW)**
  - Jurisdiction - Colorado State Wildlife Areas
  - USFWS
- **V. Colorado Department of Public Heath and Environment (CDPHE)**
  - Jurisdiction - CDPS General Permit for Stormwater Discharges Associated with Construction
  - EPA
- **VI. Colorado Department of Agriculture**
  - Jurisdiction – Colorado Noxious Weeds
- **VII. Local Government**
  - Jurisdiction – Garfield, Mesa, Rio Blanco Counties

Constant Rule Changes, Modifications & Updates

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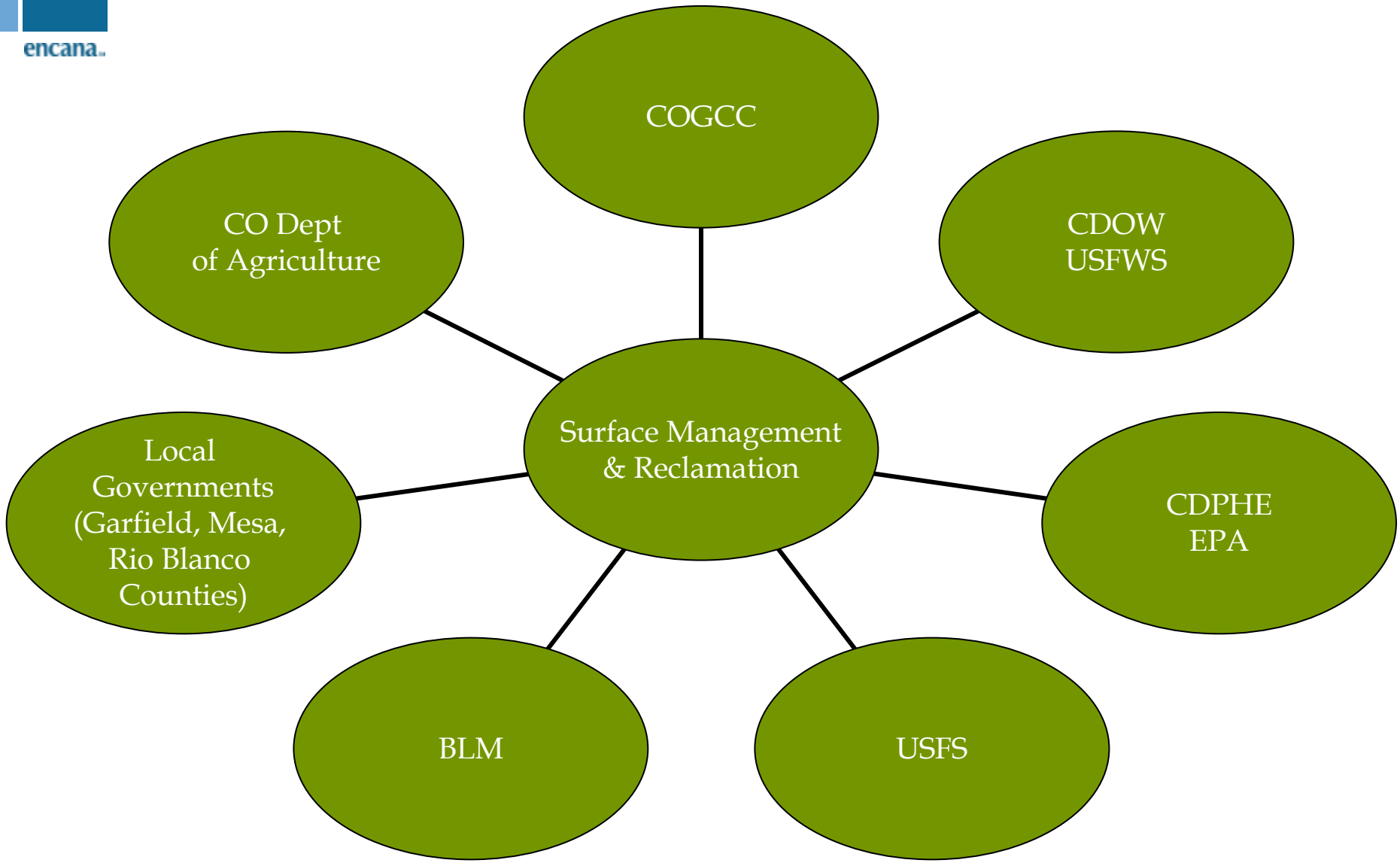
- Federal
  - BLM – Glenwood Springs Energy Office - Letter Dated May 1, 2008 – Revisions to Energy Office Revegetation Requirements
  - BLM – White River Field Office – Draft Sample Reclamation Plan Template
  - BLM – White River Field Office – Letter Date April 15, 2007 – BLM Reclamation Status Report Information
    - In RMP revision
  - BLM – Colorado River Valley Energy Office – Noxious and Invasive Weed Management Plan for Oil and Gas Operators - March 2007
  - BLM – Grand Junction Field Office – Noxious and Invasive Weed Management Plan for Oil and Gas Operators – March 2007
  - BLM - White River Field Office - Noxious and Invasive Weed Management Plan for Oil and Gas Operators
- State
  - Colorado Oil and Gas Conservation Commission –(COGCC) – Amended Final Rules – 1000 Series Reclamation Regulation
  - CDPHE WQCD – CDPS General Permit - Stormwater Discharges Associated with Construction Activity – Authorization to Discharge under the Colorado Discharge Permit System – Part I.C.4
  - Colorado Department of Agriculture – Colorado Noxious Weed Act – Article 5.5 CDOW – Garfield Creek State Wildlife Area
- County
  - Garfield County – Grading Permit Requirements
  - Garfield County – Revegetation Guidelines
  - Garfield County – Unified Land Use Resolution of 2008, as Amended – Pipelines, Section IX.
  - Garfield County – Noxious Weed Management Plan – Amended May 7, 2001
  - Mesa County – Noxious Weed Management Plan – Adopted November 30, 2009
  - Rio Blanco County – Noxious Weed Management Plan – Incomplete Draft
  - Pitkin County - Oil and Gas Regulations
  - Gunnison County - Oil and Gas Regulations

Regulatory Agencies Heavily Influence Surface Management & Reclamation Activities



Surface Management

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Petroleum Engineering and Environmentalism

"It is doubtful whether such industry pioneers as Drake, Lucas, and Muscat could have imagined the range of technical disciplines a modern petroleum engineer must understand. For many years, petroleum engineers appreciated the basic principles of geology, geophysics, and construction engineering because they are integral parts of the recovery process. Today, petroleum engineers must also be familiar with such esoteric creatures as *Mysidopsis bahia* for bioassays of discharged produced water and with *Pseudomonas* bacteria for remediation of reserve pits. Among various other scientists (such as ergonomists, economists, hydrologists, ecologists, oceanographers, and microbiologists), petroleum engineers interface with biologists for habitat management and environmental impact statements; with atmospheric physicists for air-dispersion issues; and with industrial hygienists, toxicologists, physicians, and epidemiologists concerning the effects of toxic chemicals and various diseases on worker health and safety. In addition to these hard "technical disciplines," the softer disciplines (such as psychology, community relations, and politics) cannot be ignored. All these subjects belong in the arsenal of the modern petroleum engineer."

R. Lyn Arscott, E&P Forum

The Monograph Series of the Society of Petroleum Engineers

1999

Surface Management
Planning, Designing & Managing for the Life of the Asset

- **Surface Management Paradigm:**
  - The Surface Management Paradigm is life span analysis, life span planning and life span mitigation with regards to managing Encana's activities across the landscape. It ranges from initial site and risk analysis all the way through to final abandonment.
  - We initiated the Surface Management Paradigm because our activities go well beyond stormwater management and any lack of attention to one detail adversely affects the others. **We cannot successfully manage our landscape unless we plan for stormwater, revegetation, weed control, SPCC, wildlife and reclamation over the lifespan of our assets.** Poor stormwater design and topsoil conservation adversely affects revegetation which impacts our weed management. Poor reclamation design adversely affects our operating and maintenance (O&M) cost and public perception during the production lifespan of the asset. The needs and constraints vary through the lifespan of our assets. Drilling needs and constraints vary from completions activities and so on with production and pipeline activities. The Surface Management Program incorporates a wide variety of skill sets, personnel, analysis, planning, design, construction, and maintenance.

Surface Management

planning, designing & managing for the life of the asset

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- **Principle Components of Surface Management Program:**
  - Site Analysis & Planning
  - Risk Assessment
  - People, Environment, Assets and Reputation
  - Life Span
  - Activity Phases and Operations and Maintenance
  - Establish Management Objectives
  - County, State, Federal Rules and Regulations
  - Encana Ethos/Policy
  - Part of land use decisions
  - Design, Install, Monitor and Maintain
  - Have a Plan, Install the plan, Maintain the plan, and Evaluate the plan

Life Span Planning

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- Requires Collaboration Between Multiple Departments
- Design Criteria for Multiple Activities
  - Construction, Drilling, Completions, Hook-ups, Interim Reclamation, Reoccupation and Final Abandonment.
- Reduces Redundancy and Associated cost
  - "Do it Right the First Time"
- Locations, Facilities, Pipelines and Access Roads are "Encana Billboards"

"The land is that of the land owner and we are just custodians. How well we do affects our reputation and future opportunities"

Paul Sander, VP Mid-Continent BU March 2010

Life Span Planning

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- Site Analysis
- Site Planning
- Site Design
- Execution
- Evaluation
- Improvement

Phases of Construction

- Planning and Design
- Construction
- Drilling
- Completions
- Cuttings Management
- Pit Closures
- Hook-ups
- Interim Reclamation
- Reoccupation
- P&A and Final Reclamation

Site Analysis

EnCana Oil and Gas: Cultural Resource Monitoring of Construction Activities for the 4.26NW Access Road and Pipeline, Rio Blanco County, Colorado

by
John M. Scott

prepared for
Encana Oil and Gas (USA), Inc.
370 17th Street, Suite 1700
Denver, CO 80202

prepared by
Metcalf Archaeological Consultants, Inc.
Eagle, Colorado 81631

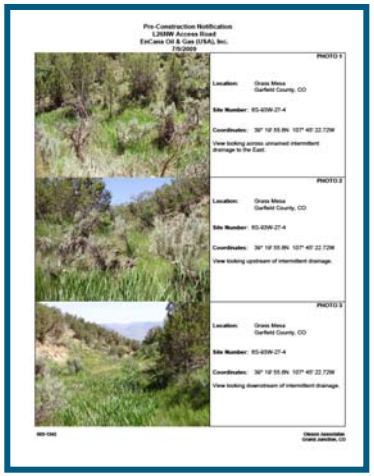
Submitted to
Cheryl Harrison
Bureau of Land Management
Glenwood Springs Field Office
2300 River Frontage Road
Silt, CO 81652

BLM Cultural Resources Use Permit C-39280
(expires 09-08-16)

November 2009

For Official Use Only: Disclosure of site locations prohibited (43 CFR 7.18)

- Analysis of Potential Sites
  - Regional Influences
  - Topographical data
  - Slopes and drainage
  - Soils
  - Water resources
  - Vegetation
  - Wildlife
  - Structures
  - Circulation
  - Visual Analysis
  - Impact Assessment
  - Preservation and Conservation
- Input from Land, Environmental, Construction, Gathering, Drilling, Completions, Production
  - Analysis of potential sites with specific scope of work in mind
    - How their scope will impact the site
    - How their scope will be impacted ***by*** the site



Pre-Construction Notification
L26NW Access Road
EnCana Oil & Gas (USA), Inc.
7/9/2009

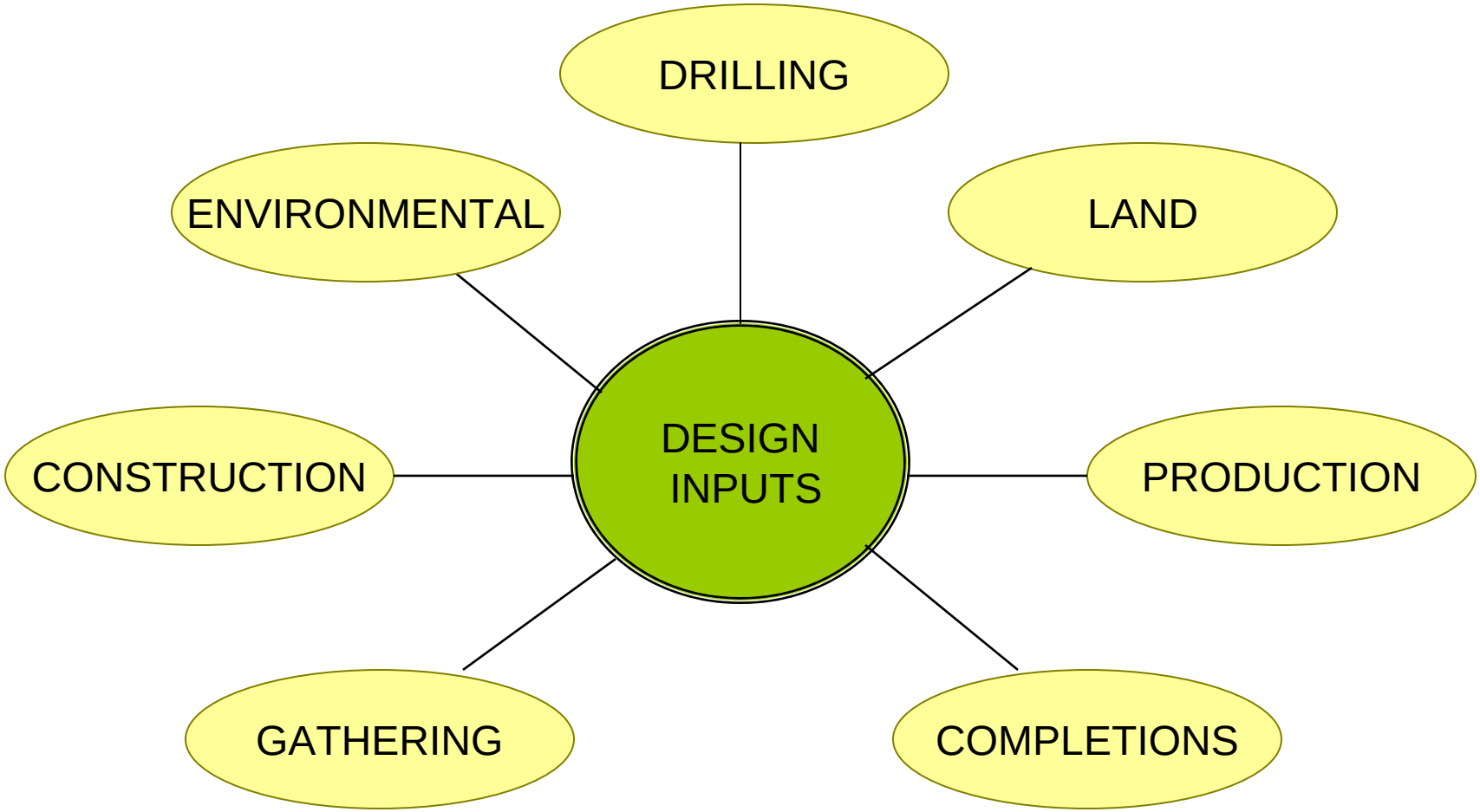
PHOTO 1
Location: Grass Mesa
Garfield County, CO
Site Number: 85-65W-27-4
Coordinates: 39° 16' 55.8N 107° 45' 22.72W
View looking across unnamed intermittent drainage to the East.

PHOTO 2
Location: Grass Mesa
Garfield County, CO
Site Number: 85-65W-27-4
Coordinates: 39° 16' 55.8N 107° 45' 22.72W
View looking upstream of intermittent drainage.

PHOTO 3
Location: Grass Mesa
Garfield County, CO
Site Number: 85-65W-27-4
Coordinates: 39° 16' 55.8N 107° 45' 22.72W
View looking downstream of intermittent drainage.

Site Planning

Communication of Opportunities, Constraints and Expectations

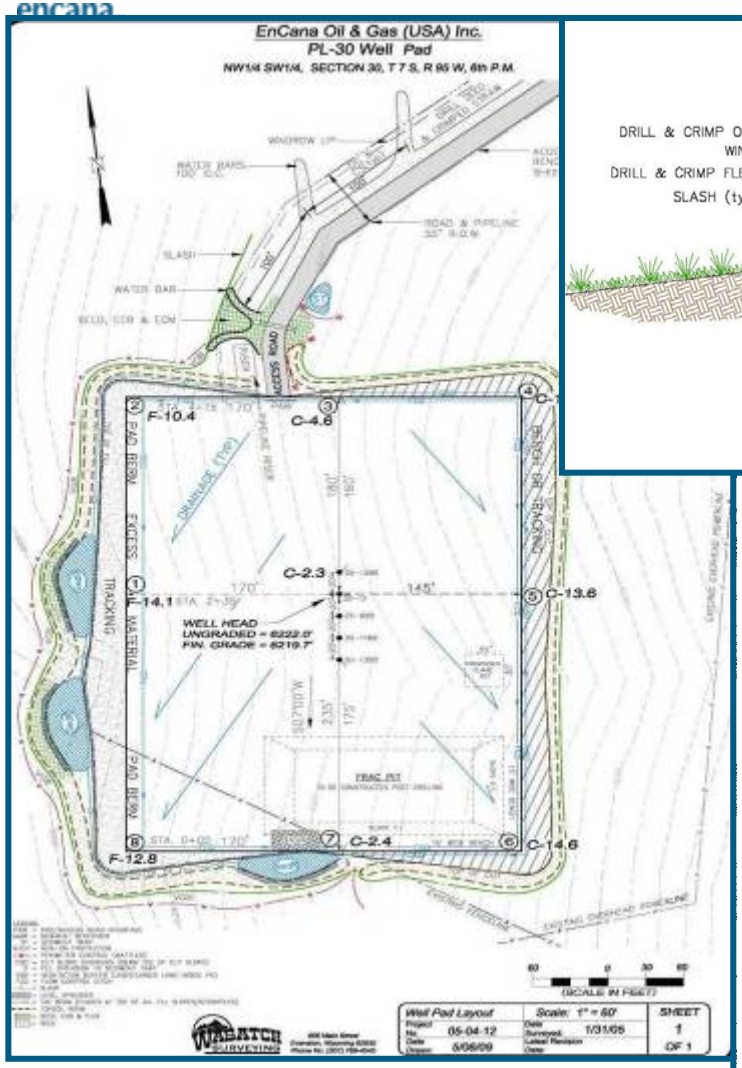


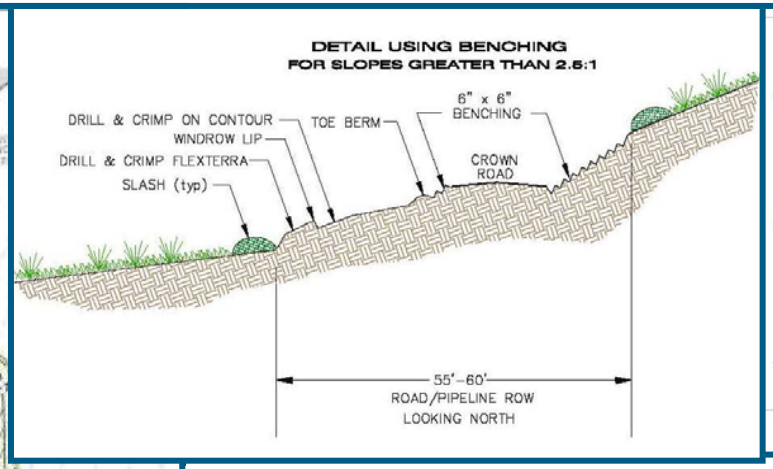
Site Design
Graphic Communication

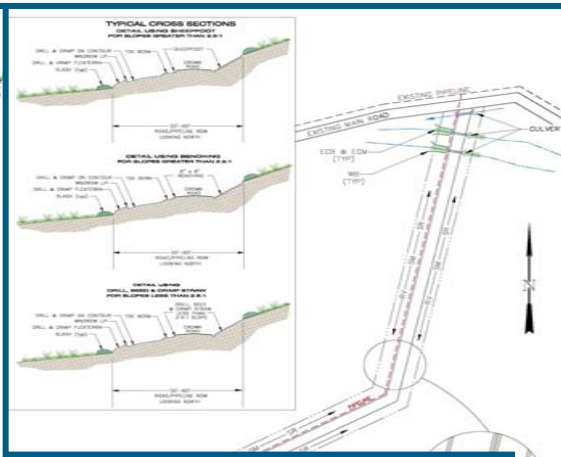
- Graphic presentation of planning solutions
  - Areas of disturbance
  - Cut & fill profiles
  - Soil & water storage areas
  - Best Management Practices
  - Erosion control
  - Drainage management
  - Natural features
  - Special Conditions
- Available for review by all work groups
- Submitted to regulatory agencies
  - Prior to Permitting

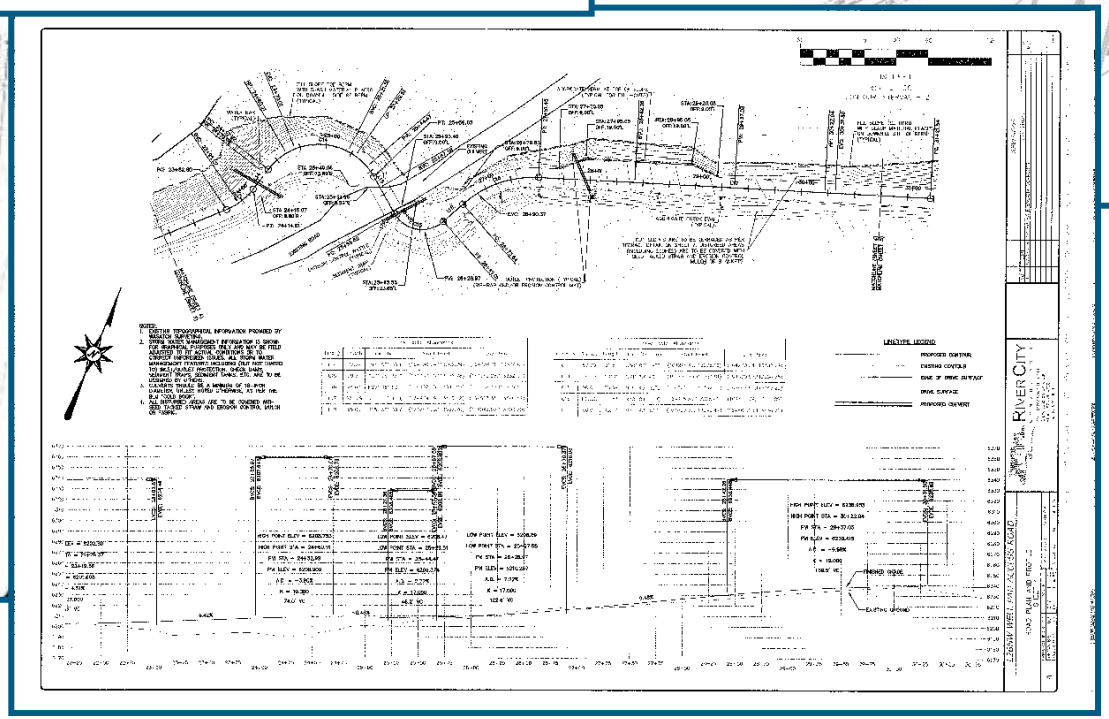
Site Design

Graphic Communication









Requires Continuous Improvement

- Execution
  - Diligent contractor and supplier selection
  - Continuous development of contractors and employees
  - Monitor construction progress
- Evaluation
  - Evaluate performance of analysis, planning, design and execution
  - Reclamation monitoring program
  - Annual site inspection program
- Improve
  - Incorporate lessons learned into future planning

Surface Management
Execution

- **The Best, Best Practices Perform Multiple Duties:**
  - A comprehensive program will maximize opportunities, minimize constraints and limit cost.

"When environmental solutions are defined and explored early in the planning-design process, they become not only a useful test but also a sound basis for the evolving studies and resulting plan solution. The negative impacts of the project can thus be reduced and the attributes significantly increased during the planning process. The many benefits of such a systematic approach cannot be overemphasized."

Bryan Whiteley
Dallas, Texas
Encana Oil & Gas (USA), Inc. July 2007

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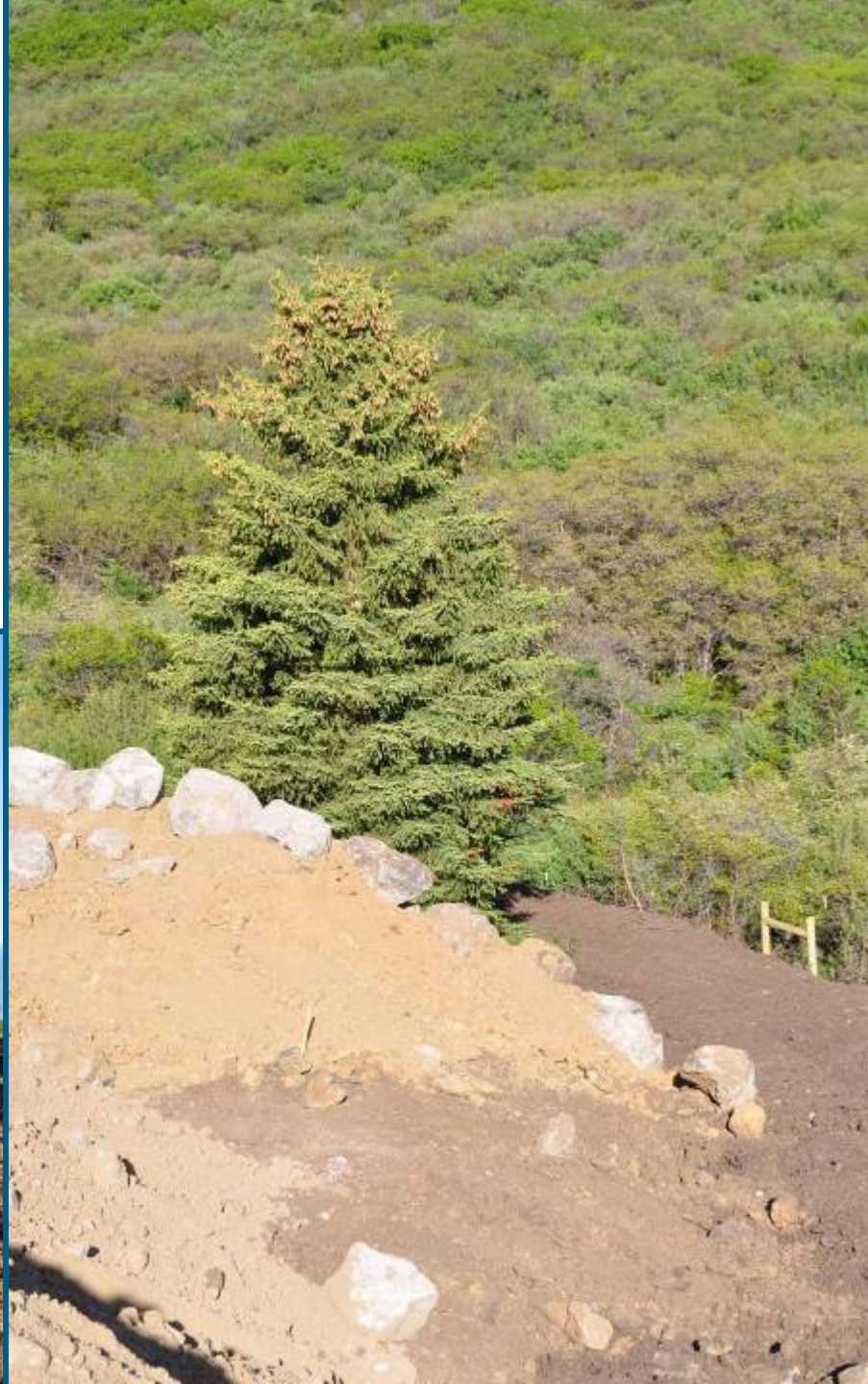
Road Construction

- Topsoil Conservation
- Vegetation Conservation
- Stormwater Management

Road Construction

Pad Construction

- Topsoil Conservation
- Wildlife
- Stormwater Management
- Rangeland Management



Pad Construction

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- Topsoil Conservation
- Stormwater Management
- SPCC
- Wildlife

Construction

- **Surface Management Impact?**
- 2 Year old road construction project well executed by Encana.
- V.S.
- Multi-decadal residential access road permitted by Garfield County.

Wildlife

- Air Quality
- SPCC
- Water Conservation

North Parachute Ranch Wildlife Mitigation Plan

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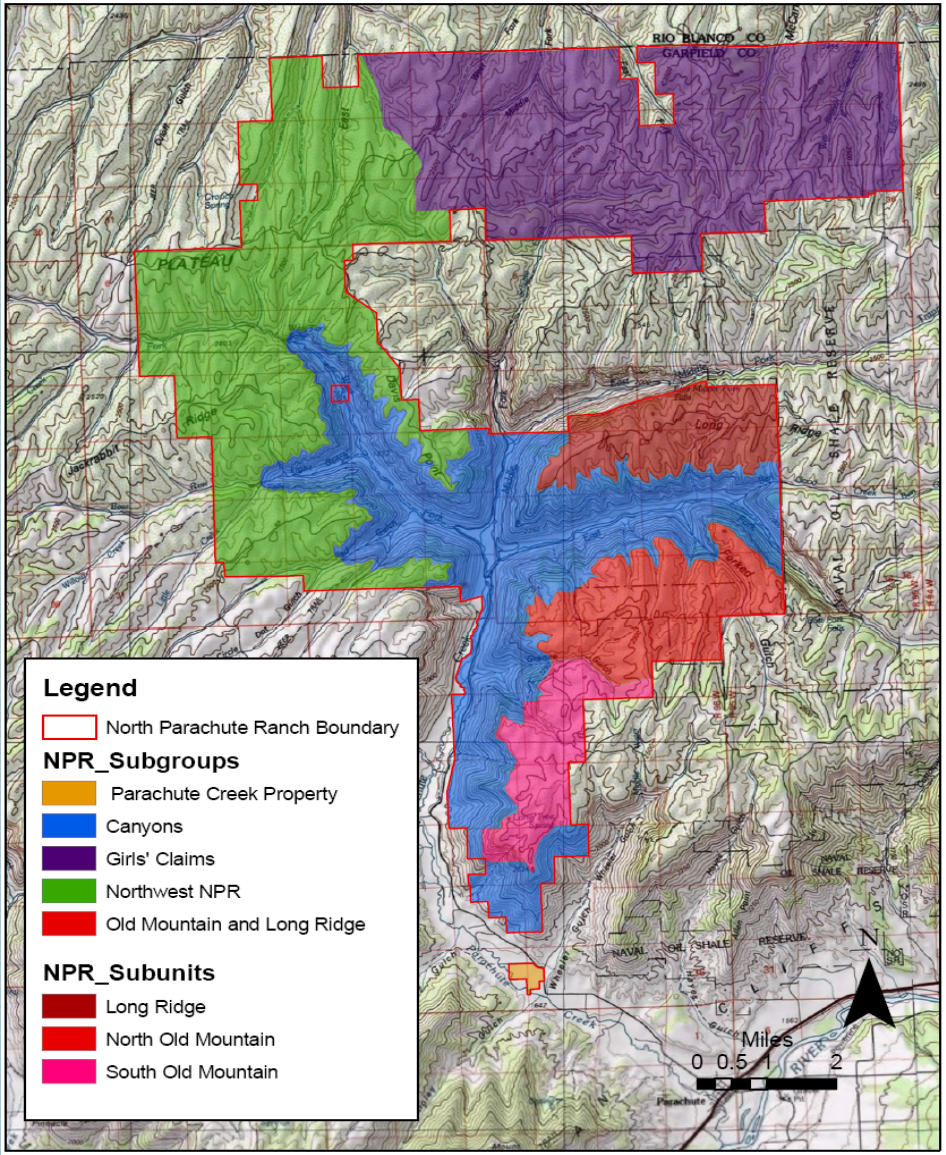
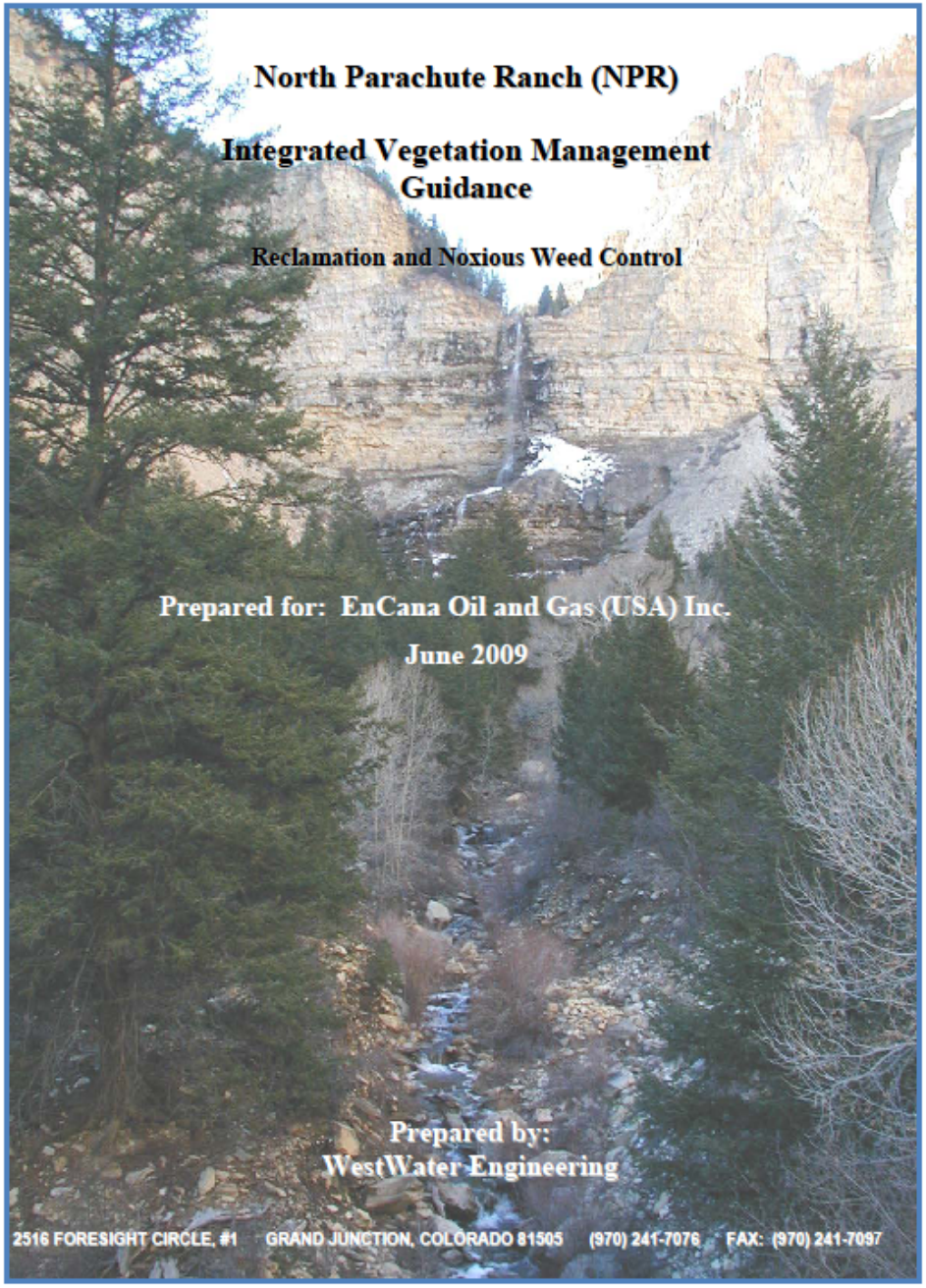
- 45,000 acre WMP based largely on processes & practices in Encana's Surface Management Program:
  - Stormwater Management
  - Reclamation practices
  - Weed Management
  - Grazing Management
  - Voluntary spatial and temporal BMPs for wildlife



Weed Management

- Having a deficient weed management program negatively impacts;
  - Wildlife
  - Vegetation Diversity
  - Revegetation Success
  - Stormwater Management
  - Public Perception
  - Long Term Cost



Inspections & Monitoring

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- The Annual Regulatory Compliance (ARC) Inspection Program
  - COGCC Form 36
    - SPCC, stormwater, air, wildlife, safety, etc.

Mamm Creek Unit (COR - 034840)

WELL NO.	T	R	SEC	PROJECT DESC.	REC. STATUS	REVEGETATED	RECONTOURED	DATE SEEDED	LENGTH (ft) (On BLM)	ACRES SEEDED	SEEDING METHOD	RECLAMATION CATEGORY
O18 to E9W	T7S	R93W	17,8,9	Pipeline	Final	Yes	Yes	2004	7,000	9.64	Broadcast	Acceptable

06/06/2007

08/13/2007

10/05/2007

- COGCC & CDPHE
  - Stormwater Inspection
- BLM/USFS
  - Reclamation Reports
- Herbicide Application Reports
- And more…….

Surface Management
Planning, Designing & Managing for the Life of the Asset

- Using a comprehensive holistic approach incorporating site analysis, site planning, site design, execution, evaluation and constant pursuit of improvement provides benefits.
- **Benefits**
  - Operational efficiency
  - Long term cost savings
  - Reduction of risk
  - Increased Safety
  - Increased Regulatory Compliance
  - Affects relationship with regulatory agencies
  - License to operate
  - Heavily impacts reclamation outcomes

Five Reclamation Best Practices

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- Topsoil Conservation
  - Topsoil Windrows/Perimeter Berms
  - Long term stormwater management BMP
- Surface Roughening
  - Erosion Control
  - Moisture Conservation
- Mulching
  - Erosion Control
  - Moisture Conservation
  - Topsoil Conservation
- Landforming
  - Stormwater Management
  - Multiple aspects and associated vegetation
  - Hydraulically influenced vegetation patterns
  - Visual aesthetics
- Visual Resource Management/Mitigation
  - VRM/Mitigation (BLM/USFS/COGCC)
  - Visual aesthetics (Because they're our neighbors)

Topsoil Conservation

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- **Surface Management:**
  - Topsoil is not a thing that you pile up temporarily and spread later
  - Its needs to be one part of the overall surface management analysis, planning, design and implementation over the life of the asset
  - When topsoil conservation is incorporated into surface management topsoil can become more than a pile of dirt it can be part of your:

Topsoil Windrowing/Perimeter Berms

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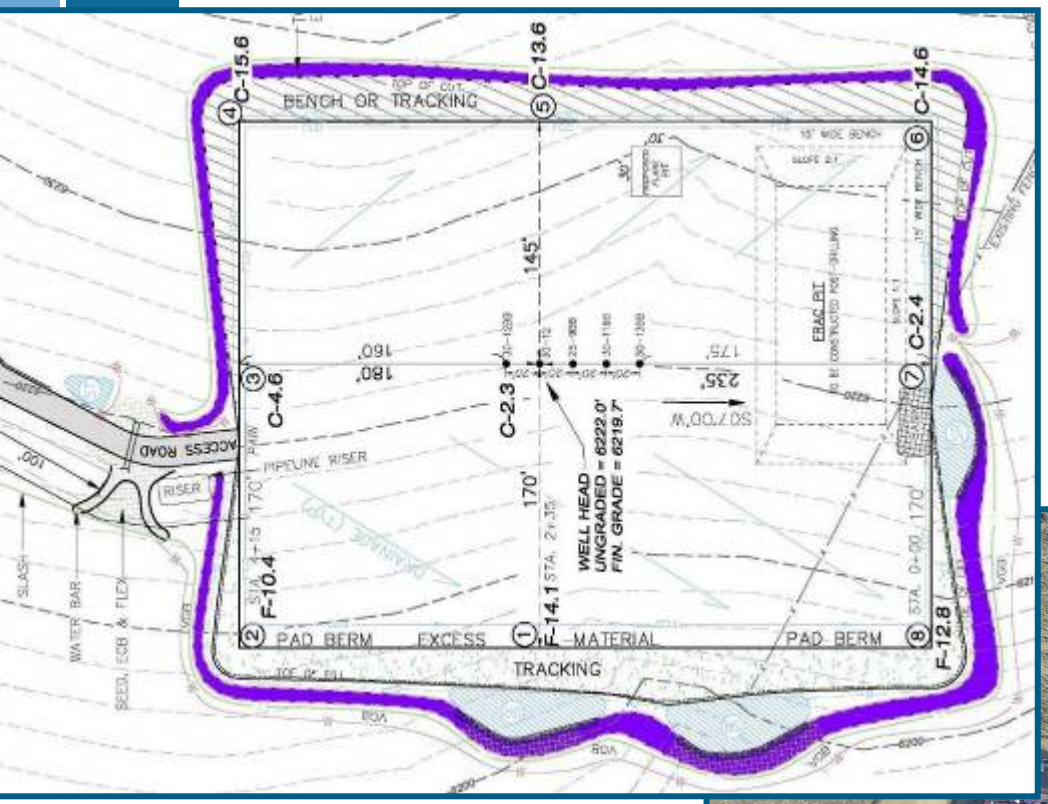
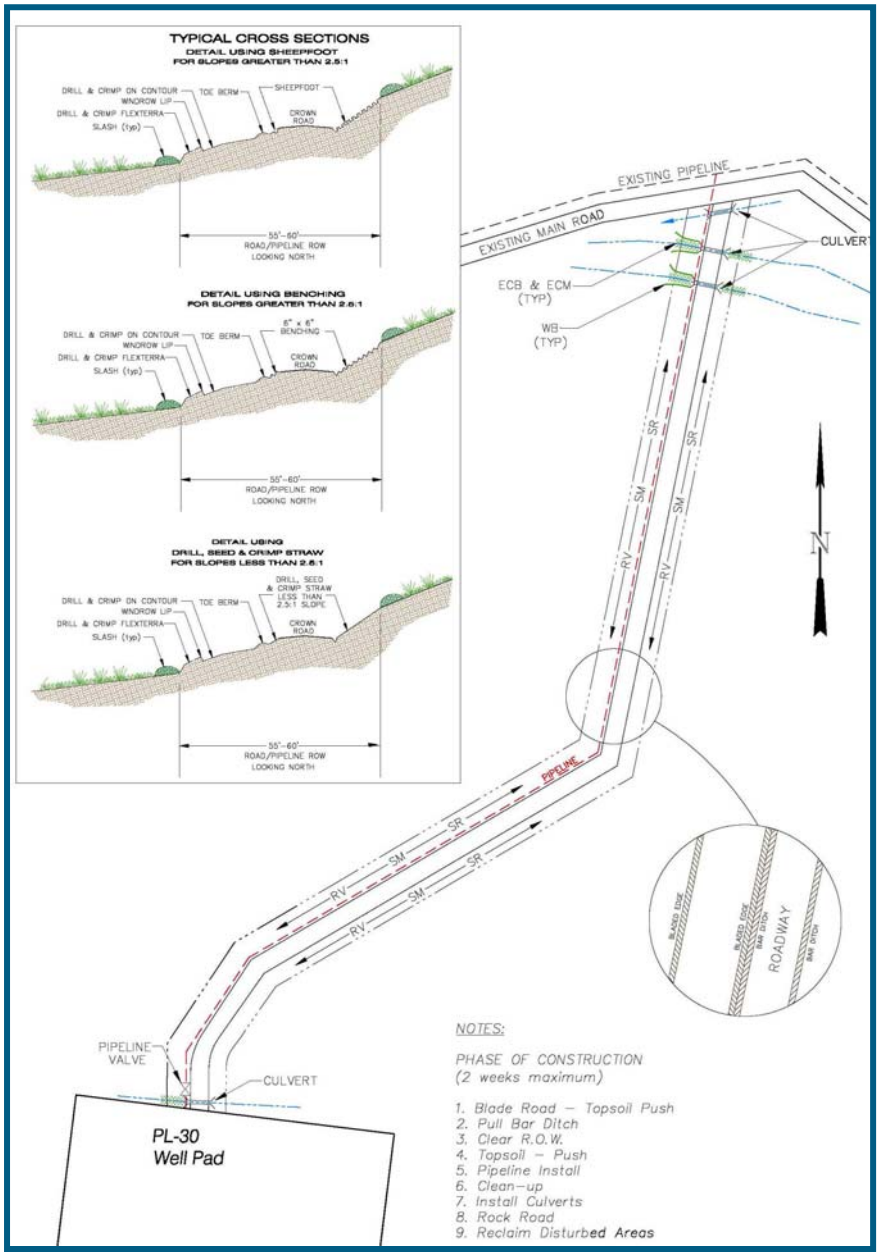
- **BENEFITS:**

- Keeps different soil types separated, stores topsoil in its relative areas and provides defined placement areas.
- Maximized surface area for sustaining biological soil activity
- Generates a highly stable landform
- Now promoted by Jim Perry NRS of BLM Washington Office
- Allows for more cost effective seeding and erosion control BMP's
  - Can performs multiple duties as a stormwater, visual and or acoustic BMP in your surface management practices
- Maintains perimeter control during reclamation

Topsoil Conservation:



Topsoil Conservation:



Surface Roughening - Tracking

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Can add compaction in some soil types and moisture conditions.

Easy and effective.

Surface Roughening - Tracking

Tracking can be accomplished simultaneously with typical earthwork operations. Allowing for temporary erosion control to be in place at the end of each work day.

Surface Roughening – Mini-Benching

Difficult to do well.

Visible horizontal pattern.

Surface Roughening – Mini-Benching

Mini-benching hand pocked when location interim reclaimed.

Surface Roughening – Ripping on Contour

Surface Roughening – Ripping on Contour

Visible Horizontal pattern.

Easy: slope specific because of safety concerns.

Surface Roughening – Corrugating

Not necessarily easy, but is effective.

Creates visual pattern and concentrated flows.

Surface Roughening – Corrugating

Continuous road side ditch relief for sediment control and irrigation.

Surface Roughening – Hand/Track Hoe Pocking

More time consuming but maximizes water conservation and vegetation density.

Surface Roughening – Hand/Track Hoe Pocking

Track hoe pocking first followed by hand pocking. Notice the <u>shadows!</u> This is our standard BMP for slopes that interface native run-on.

Surface Roughening – Sheep's Foot

Making concrete? conserving available soil moisture through micro-catchments more impactful than soil compaction?

Sheep's Foot Compactor Pocking

Tight micro-catchment spacing similar to hand pocking. Shadows!

Surface Roughening – Sheep's Foot

Seeding with amendments and erosion control hydraulic mulch. Full SW Exposure

Surface Roughening – Free Form

No finish grading means
no finish grading cost!

Surface Roughening – Free Form

Surface Roughening – Free Form

No patterns, everything goes……..

Surface Roughening – Free Form

Very fast and low cost.

Mulching – Moisture & Topsoil Conservation

Corrugating & Crimped Straw Mulch

Mulching – Moisture & Topsoil Conservation

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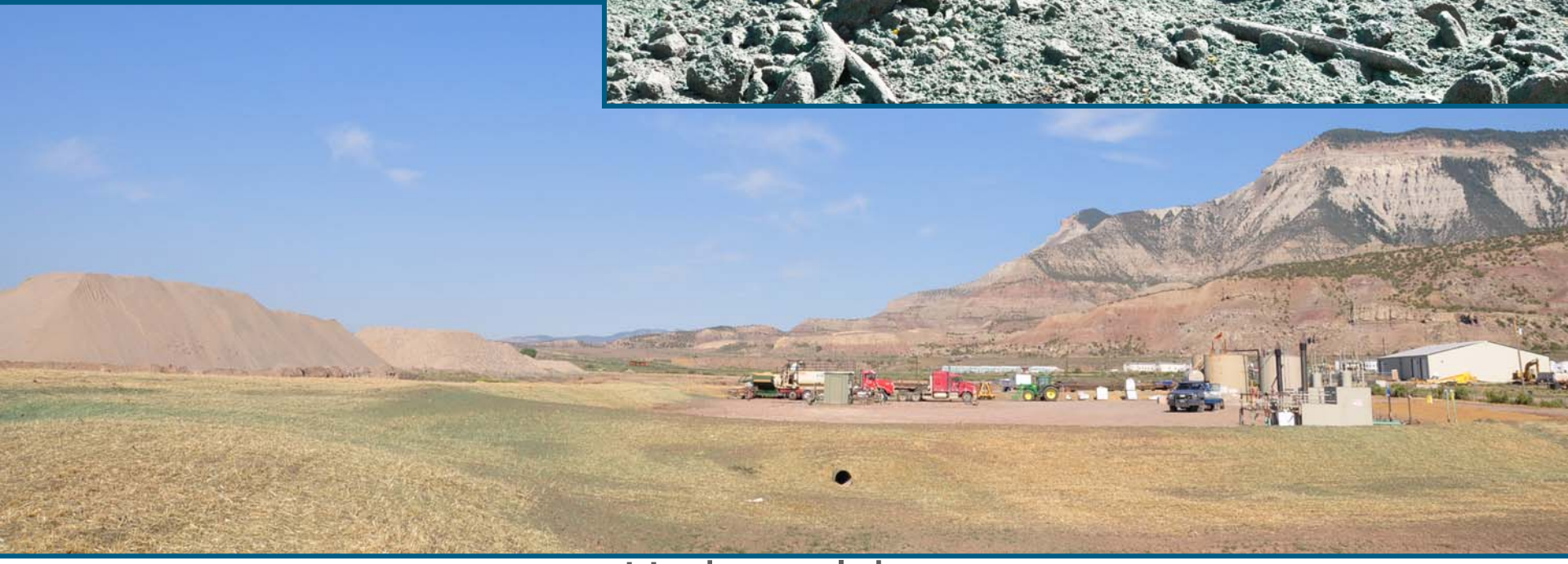
Corrugating & Crimped Straw Mulch

Mulching – Moisture & Topsoil Conservation

Erosion Control Blanket with Hydromulch Infill

Mulching – Moisture & Topsoil Conservation



Hydromulch

Mulching – Moisture & Topsoil Conservation

Hydromulch
Infill & Tacking

Mulching – Moisture & Topsoil Conservation

Hydromulch

LANDFORMING

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- LANDFORMING
  - Landform grading essentially attempts to:
    - Respect the underlying, basic landforms by preserving or replicating them and their associated vegetative patterns.
    - Re-create or mimic the important, stable natural hillsides with their rich variety of different slope elements and forms.
  - **Landscape Architecture Definition**
    - Creating stable landforms that are visually compatible with the surrounding natural landscape and in harmony with regional vegetation patterns and surface hydrology.

Landforming: Grading

There are five different watersheds within this reclaim

Landforming: Grading & Watershed

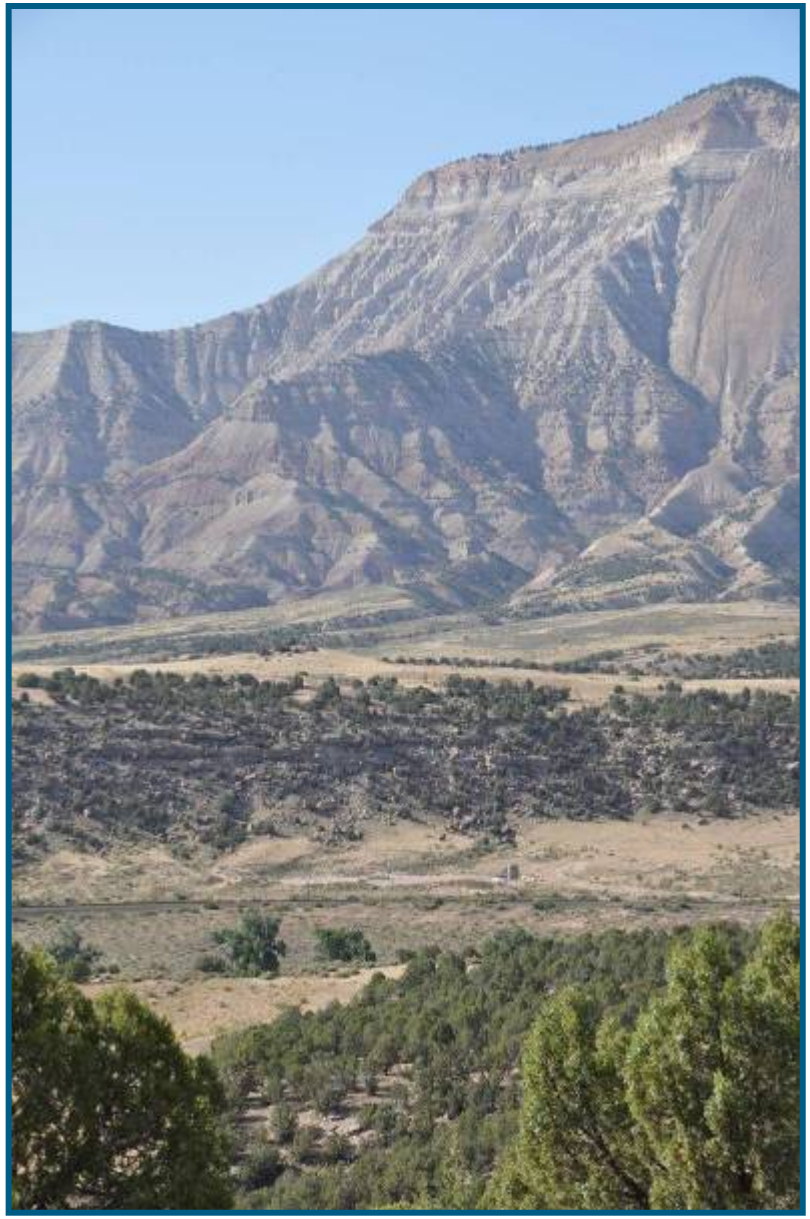
There are five different watersheds within this reclaim

Landforming: Stormwater

Landforming: Stormwater

Landforming: Soil Influenced Vegetation Patterns

Landforming:
Hydrology Influenced Vegetation Patterns



Visual Resource Management/Visual Mitigation

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- Colorant/Camouflage

Visual Resource Management/Visual Mitigation

- Colorant/Camouflage

Visual Resource Management/Visual Mitigation

- Colorant/Camouflage

Visual Resource Management/Visual Mitigation

- Colorant/Camouflage

LANDFORMING: Visual Resource Management

LANDFORMING: Visual Resource Management

LANDFORMING: Sound Management

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Types of Reclamation

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- **Initial Construction**
  - Access Roads & Pipelines
    - Immediate reclamation upon completion of construction activities.
  - Compressor Stations & Other Facilities
    - Same as above
- **Interim Reclamation**
  - Well Pads
    - Public Lands and/or Connected Activity
      - Old School
      - Pre-Final
      - (VRM) Visual Resource Management/Mitigation
      - Combo
    - Private Property
      - Its what ever the land owner wants within the scope of the original lease while accommodating operations requirements.
- **Final 'Abandonment' Reclamation**
  - Public Land
    - Typically a final reclaim
    - However, as the public land use changes so do the land management objectives
      - Campground, ATV/snowmobile parking, horse trailer parking, hunting camp, scenic overlook, etc…
  - Private Land
    - Its what ever the land owner wants within the scope of the original lease.
      - Final reclaim, horse arena, hat barn pad, home pad, storage, junk storage, etc…

Initial Construction

Initial Construction

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Initial Construction: The Following Spring

Reclamation

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- Interim Reclamation
  - During interim reclamation the facility is reduced to its minimum size that allows for efficient and effective production and maintenance.
  - Limiting factor is usually designing for the workover rigs.
  - Does not usually include recompletions but does not hurt to accommodate this need if possible.
  - This is the longest time span or phase of our assets life, the quality of the planning and site design has a great impact on our reputation, LOE budget and now, how we prove our reserves.
  - Because this is the longest portion of our assets life the owners (operations) should have a say in everything that happens before the long term production life phase.
  - Poorly planned and executed reclamation increases the cost of ownership and effects our reputation.

Interim Reclamation – Pre-Final

Interim Reclamation – Pre-Final

Interim Reclamation – VRM

Interim Reclamation – VRM

Interim Reclamation – Combo

Interim Reclamation – Combo

Interim Reclamation – Combo

Interim Reclamation – Combo

Reclamation

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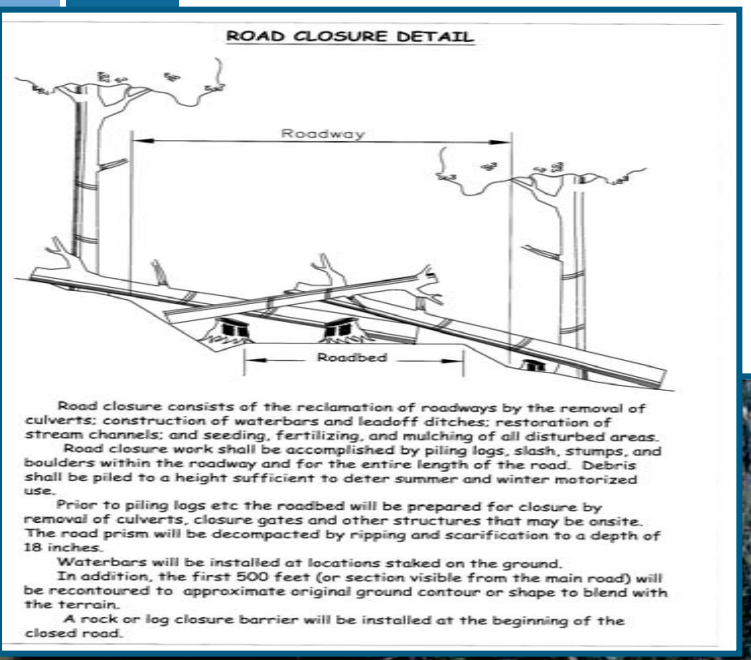
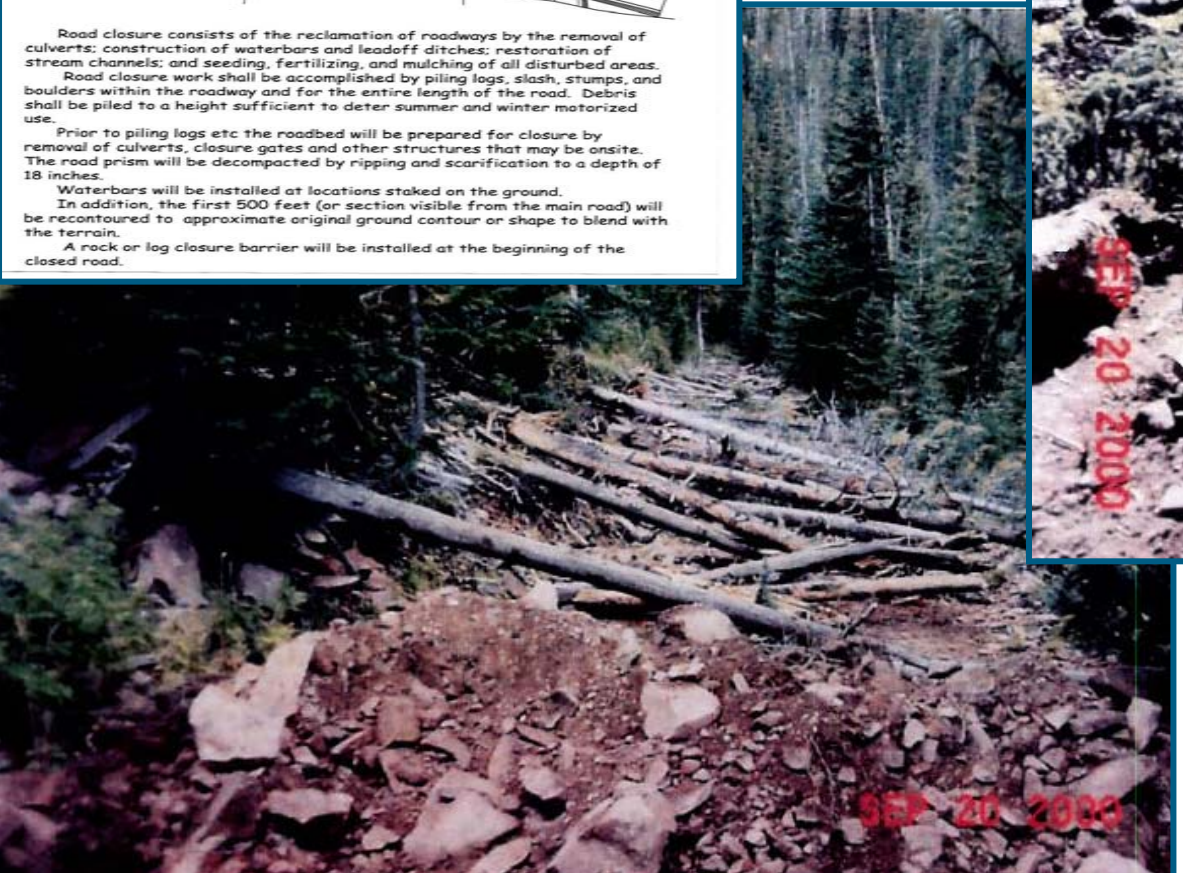
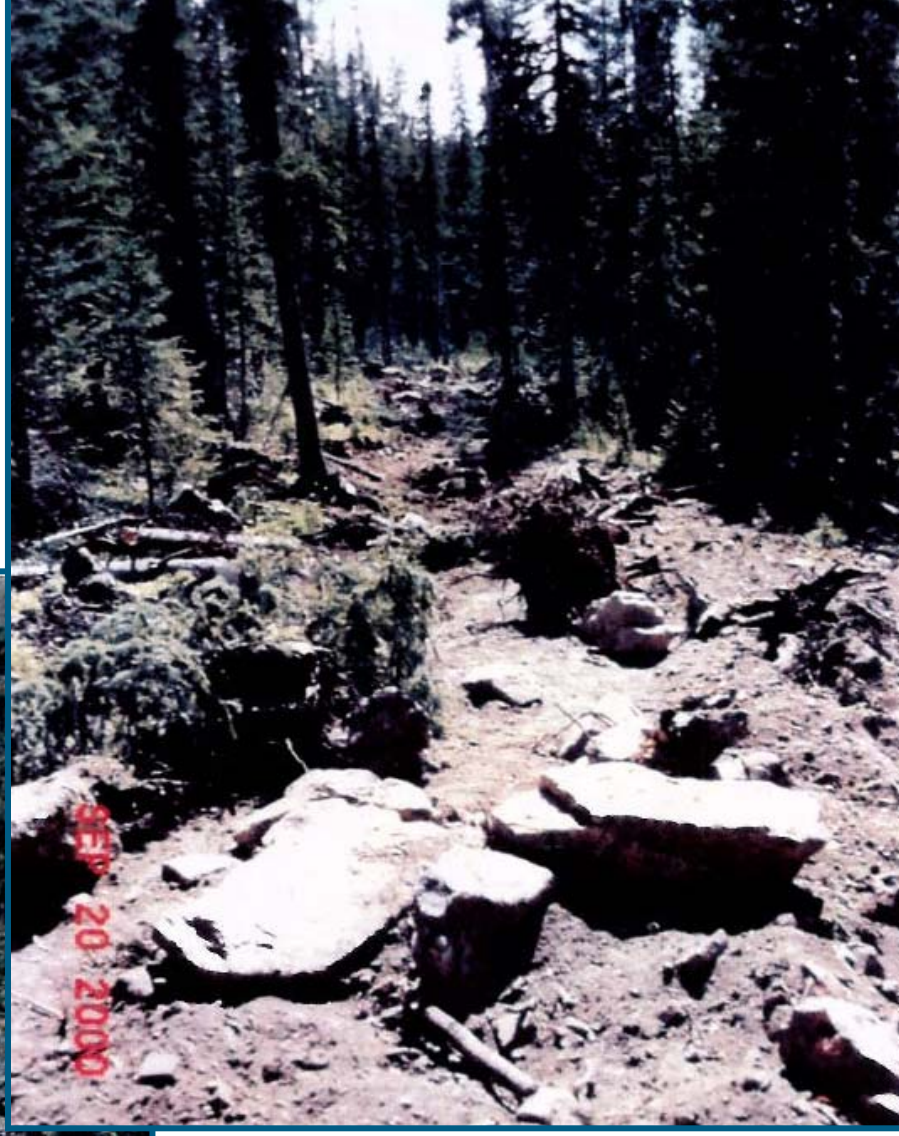
- Final Reclamation
  - Plug and abandonment of well and pipeline
  - Final abandonment is restoring surface to its original contours and revegetation.
  - Sometimes depending on the quality of the interim reclamation and/or site specifics the landowner will desire the site be left as is.

Final Reclamation

Final Reclaim – Old School







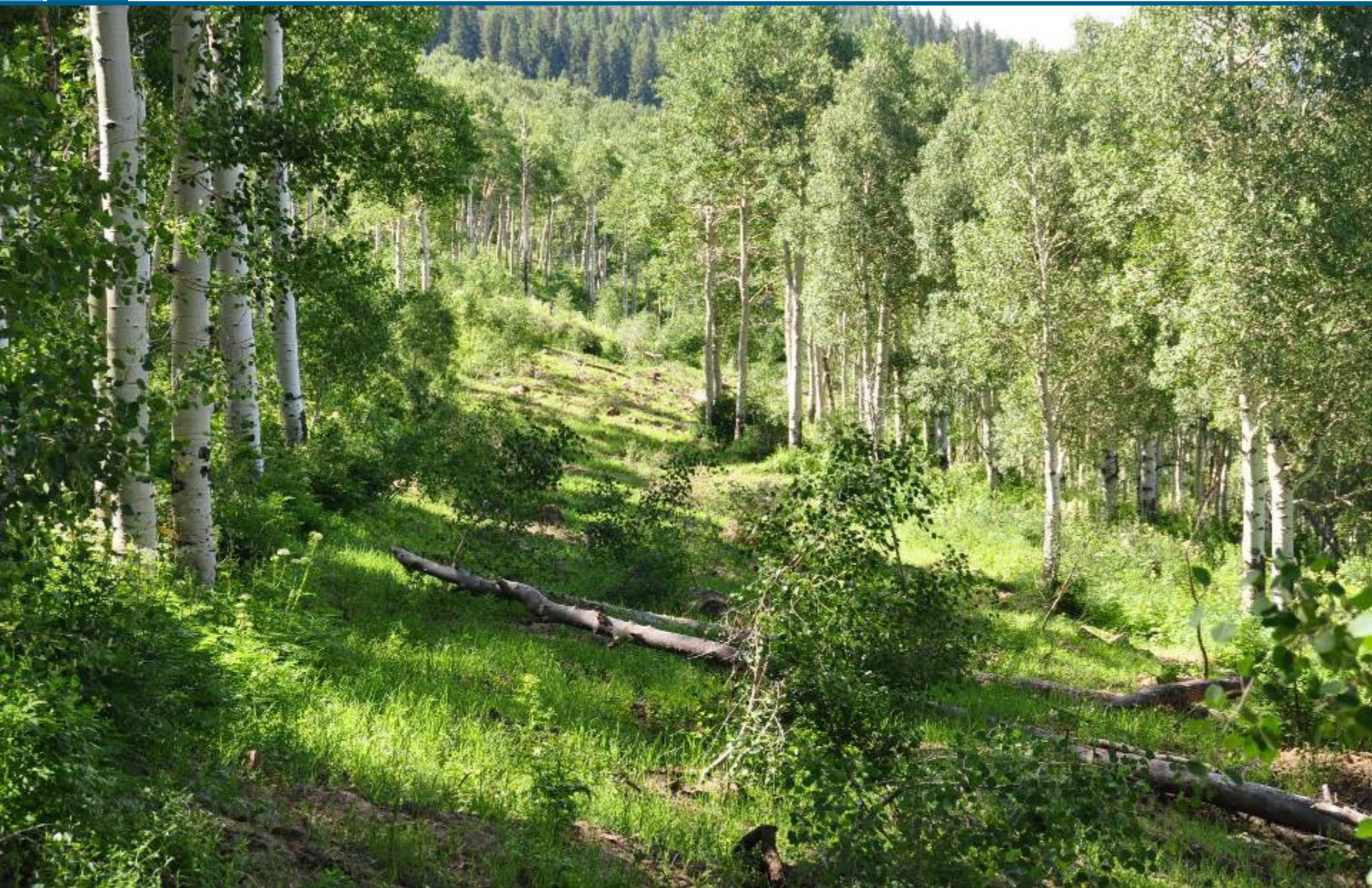
- Detail & photographs provided by White River National Forest

Final Reclaim - Today

Final Reclaim - Today

Final Reclaim - Today

Final Reclaim - Today



2010 Divide Creek Scope

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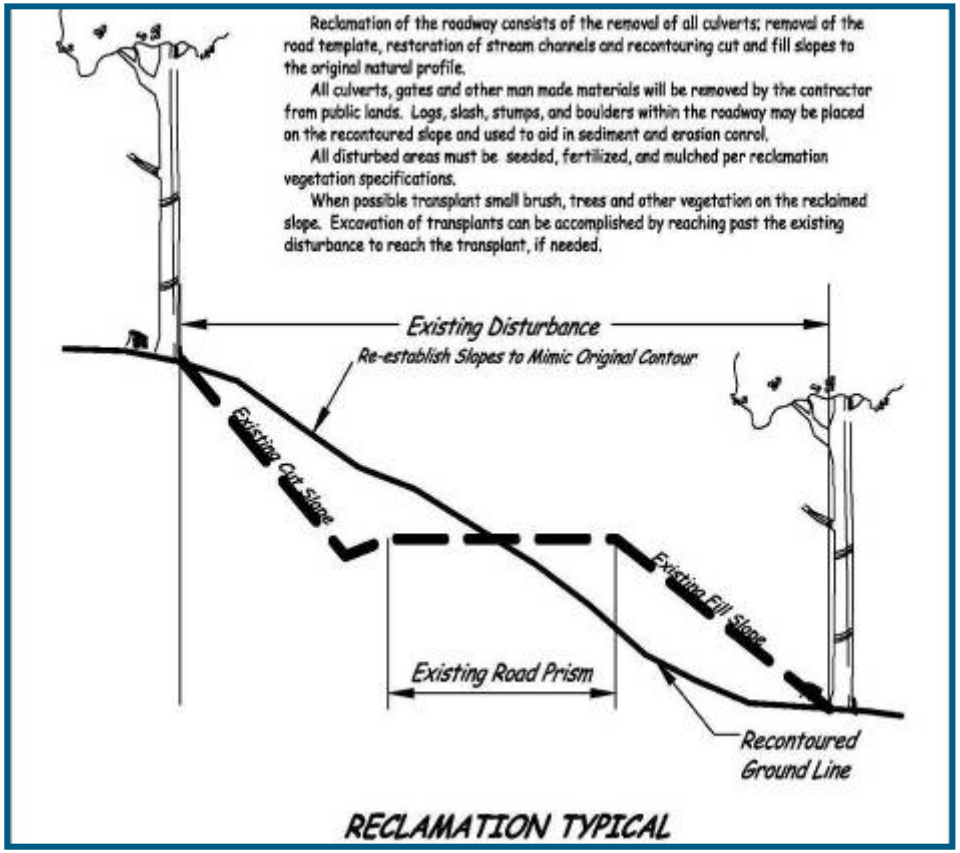
- 2010 Scope based on 2006 Mamm Creek final reclaim
- Addressed VRM
- Addressed plant diversity
- Addressed limits constraints
- 2006 Mamm Creek Final had soil compaction & logistics issues
- 2006 Mamm Creek Final has less topography issues



Divide Creek Final Reclaim

Highlights

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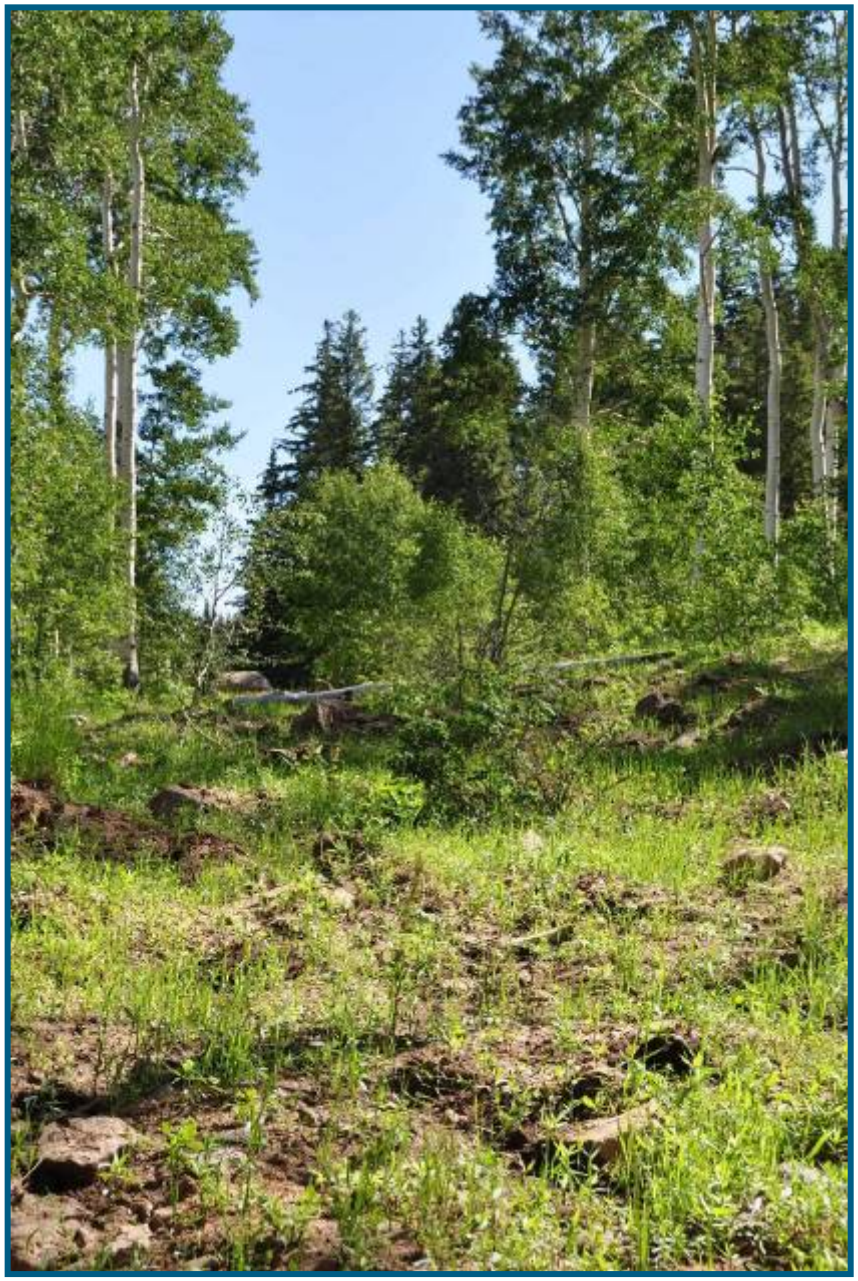
- Accelerated seral succession and unprecedented plant diversity
- Outstanding VRM
- Proved efficacy of flexible limits
- Resolved logistics issues
- Resolved compaction issues
- Approx. 4000’ & 5 ac. in 4.5 days
- Earthwork cost $4,320.00 plus mobilization
- Seeding cost $26,000.00
- Aggressive weed management took place prior to first USFS visit in 2011



Seed Mixes

encana.

- On Public Lands
  - The Land Manager dictates the seed mix.
  - If you perform you own vegetation, weed and soil assessment and don't agree with the dictated mix an operator can propose an amended seed mix.
- On Private Property
  - Landowner dictates.
  - When a landowner is not sure what they want, Encana will usually recommend a BLM seed mix or a mix which matches their desired land use.
- On Encana Land
  - Dictated by our Wildlife Management Plans

Table 1-1. Low-Elevation Salt-Desert Scrub/Basin Big Sagebrush

Common Name	Scientific Names	Variety	Season	Form	PLS lbs/acre*
Plant Both of the Following (5% Each, 10% Total)					
Fourwing Saltbush	*Atriplex canescens*			Shrub	1.9
Shadscale	*Atriplex confertifolia*			Shrub	1.5
and Both of the Following (20% Each, 40% Total)					
Galleta	*Pleuraphis [Hilaria] jamesii*	Viva florets	Warm	Bunch	2.5
Alkali Sacaton	*Sporobolus airoides*	Salado	Warm	Bunch	0.2
and One of the Following (20% Total)					
Streambank Wheatgrass	*Elymus lanceolatus ssp. psammophilus, Agropyron riparium*	Sodar	Cool	Sod-forming	2.5
Western Wheatgrass	*Pascopyrum [Agropyron] smithii*	Arriba	Cool	Sod-forming	3.6
and Two of the Following (15% Each, 30% Total)					
Indian Ricegrass	*Achnatherum [Oryzopsis] hymenoides*	Nezpar, Paloma, Rimrock	Cool	Bunch	2.1
Bottlebrush Squirreltail	*Elymus elymoides, Sitanion hystrix*		Cool	Bunch	1.5
Slender Wheatgrass	*Elymus trachycaulus, Agropyron trachycaulum*	San Luis, Pryor	Cool	Bunch	1.8
Sandberg Bluegrass	*Poa sandbergii (Poa secunda)*		Cool	Bunch	0.3

**Based on 45 pure live seeds (PLS) per square foot, drill-seeded. Double this rate (90 PLS per square foot) if broadcast or hydroseeded.*

APPENDIX B

MENU-BASED SEED MIXES BY HABITAT TYPE FOR USE IN INTERIM AND FINAL RECLAMATION

Table B-2. Pinyon-Juniper Woodland and/or Mountain/Wyoming Big Sagebrush Shrubland

Common Name	Scientific Names	Variety	Season	Form	PLS lbs/acre*
Plant Both of the Following (15% Each, 30% Total)					
Bottlebrush Squirreltail	*Elymus elymoides, Sitanion hystrix*	VNS	Cool	Bunch	2.0
Bluebunch Wheatgrass	*Pseudoroegneria spicata, Agropyron spicatum*	Secar, P-7, Anatone, Goldar	Cool	Bunch	2.8
and Two of the Following (20% Each, 40% Total)					
Thickspike Wheatgrass	*Elymus lanceolatus ssp. lanceolatus, Agropyron dasystachyum*	Critana, Bannock, Schwendimar	Cool	Sod-forming	3.4
Slender Wheatgrass	*Elymus trachycaulus, Agropyron trachycaulum*	Revenue, Pryor	Cool	Bunch	3.3
Western Wheatgrass	*Pascopyrum [Agropyron] smithii*	Rosana, Arriba	Cool	Sod-forming	4.8
and Two of the Following (15% Each, 30% Total)					
Indian Ricegrass	*Achnatherum [Oryzopsis] hymenoides*	Paloma, Rimrock	Cool	Bunch	2.8
Galleta	*Pleuraphis [Hilaria] jamesii*	Viva florets	Warm	Bunch/Sod-forming	2.5
Muttongrass	*Poa fendleriana*	VNS	Cool	Bunch	0.4
Sandberg Bluegrass	*Poa sandbergii, Poa secunda*	VNS	Cool	Bunch	0.4

*Based on 60 pure live seeds (PLS) per square foot, drill-seeded. Double this rate (120 PLS per square foot) if broadcast or hydroseeded.

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Questions?

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