U.S. Department of the Interior
Bureau of Land Management

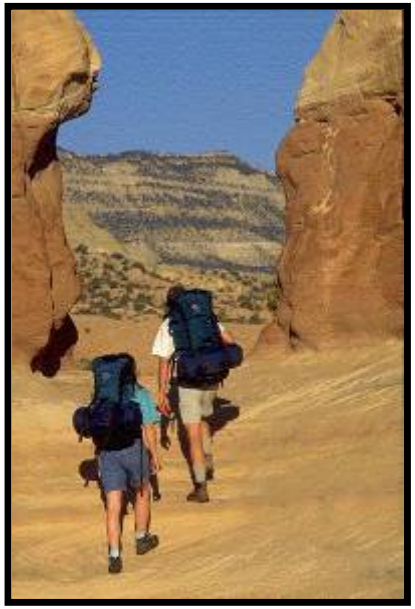
March 2014

Introduction to BMPs

Best Management Practices for Fluid Minerals

Outstanding Resources

The BLM manages many outstanding resources, including important wildlife habitat, scenic western landscapes, flowing streams & rivers, recreational opportunities, and many others.



The BLM's Goal is Sustainable Energy Development

Meeting the needs of the current generation, without compromising the ability of future generations to meet their needs.

Photo of a lower impact two-track road into a drilling operation.

- This road follows the contour of the land to avoid straight lines and cut & fill. The well location is mowed, not excavated, to temporarily reduce vegetation. Only the rig and pit areas are excavated.

Environmental Impacts Are Not Permanent

Oil & Gas Exploration and Production is temporary or long-term, but not a permanent use of the Public Land. Over time, nearly all traces of energy development should be erased.

Development Over Time

Phase 1: Resources at Pre-Development:

Wildlife; Soils; Water; Air; Recreation; Visual; Vegetation; Grazing; etc.

Phase 2: Resources During Energy Development:

Energy; Wildlife; Soils; Water; Air; Recreation; Visual; Vegetation; Grazing; etc.

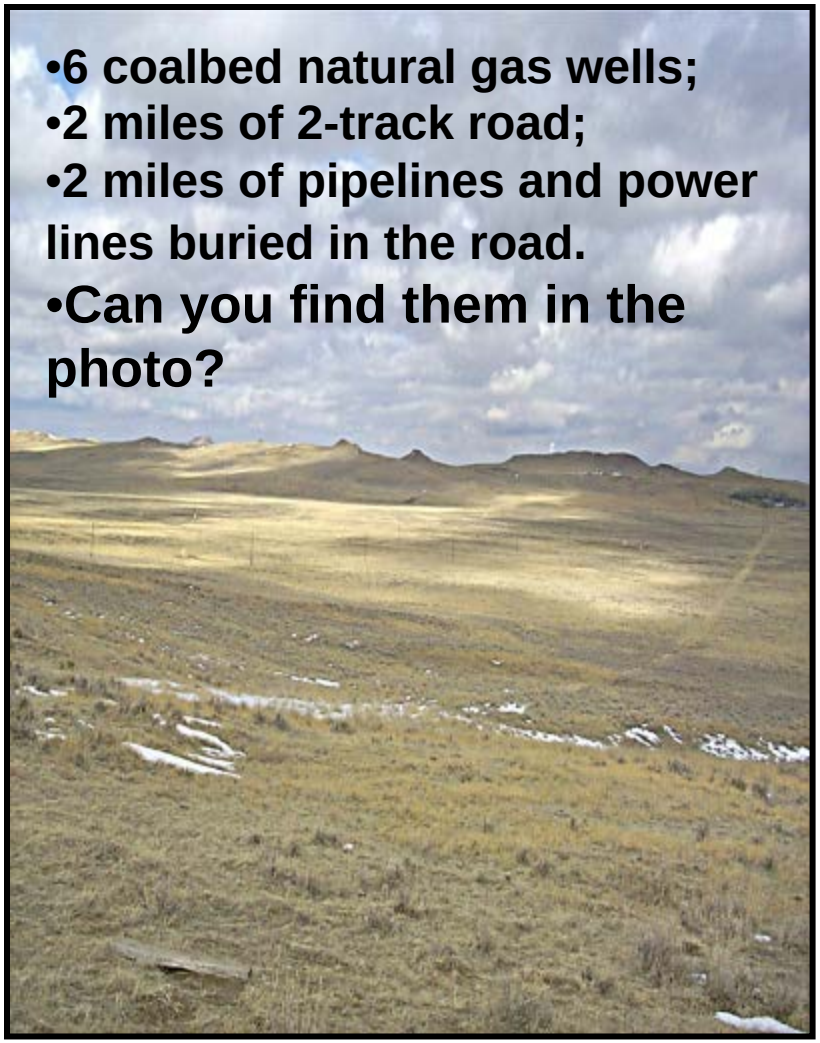
Phase 3: Resources Following Field Reclamation:

Wildlife; Soils; Water; Air; Recreation; Visual; Vegetation; Grazing; etc.

Traditional Development

BMP Development

Both Photos Represent Extremes –We can learn much from the photo on the right.



BMP Objective: To Minimize the Footprint of Oil and Gas Operations

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Wildlife Management

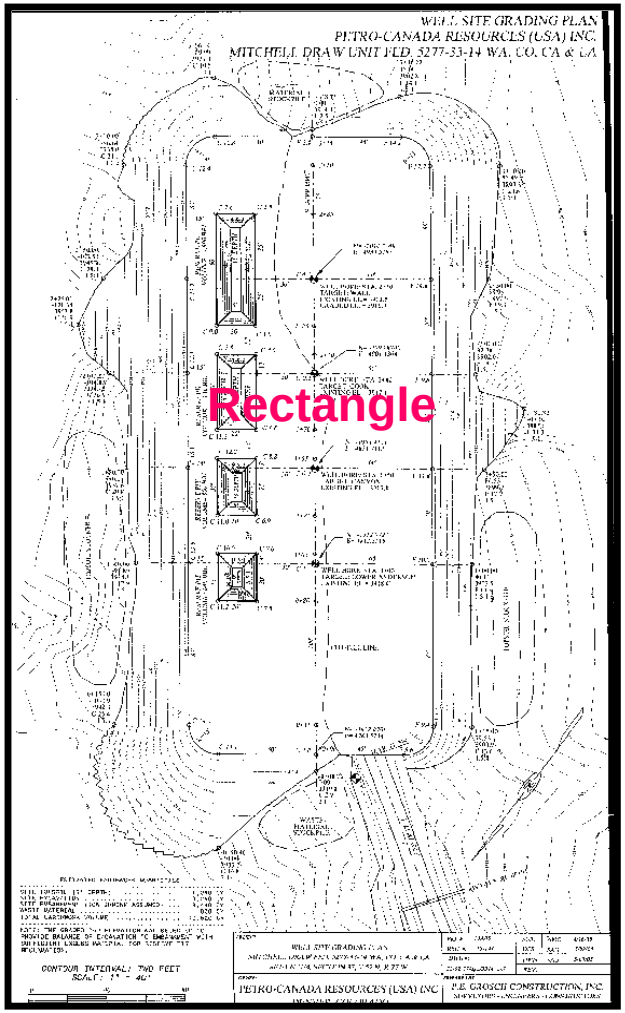
Best Management Practices for Fluid Minerals

BMPs Minimize Wildlife Mortality and Habitat Fragmentation

Typical BMPs May Include:

- Reducing the Initial and Interim Size of Roads and Well Pads.
- Corridoring Buried Pipes and Power next to the Road.
- Drilling Multiple Wells from a Single Well Pad.
- Eliminating Mortality Hazards to Wildlife.
- Reducing Noise and Traffic.
- Centralizing Production Facilities Off Site.
- Remote Production Monitoring.

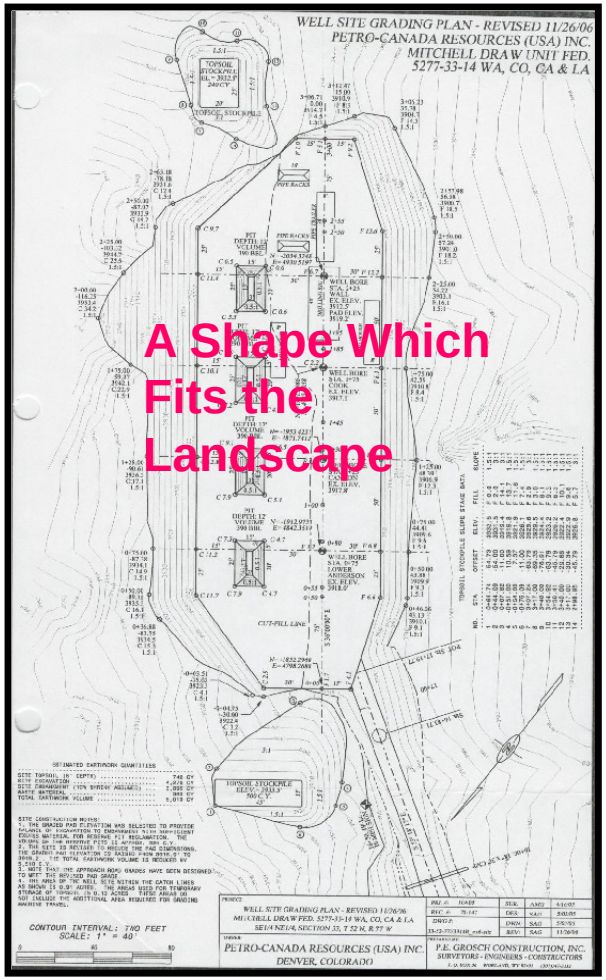
Pad Design to Minimize Disturbance



Area: 1.3 acres
Total Dirt Moved:
10,520 cy yd

Pads do <u>not</u> have to be rectangular.

Result →
- Less disturbance
- Less habitat loss
- Less reclamation
- Less cost to build



Area: 1.0 acres
Total Dirt Moved:
5,010 cy yd

Interim Reclamation

Interim reclamation should begin shortly after construction or establishing oil or gas production on the site.

If the disturbed areas are covered with topsoil and seeded with appropriate amounts and varieties of native species, over time, local natives will typically reestablish themselves on the site, helping to restore proper species composition and structure.

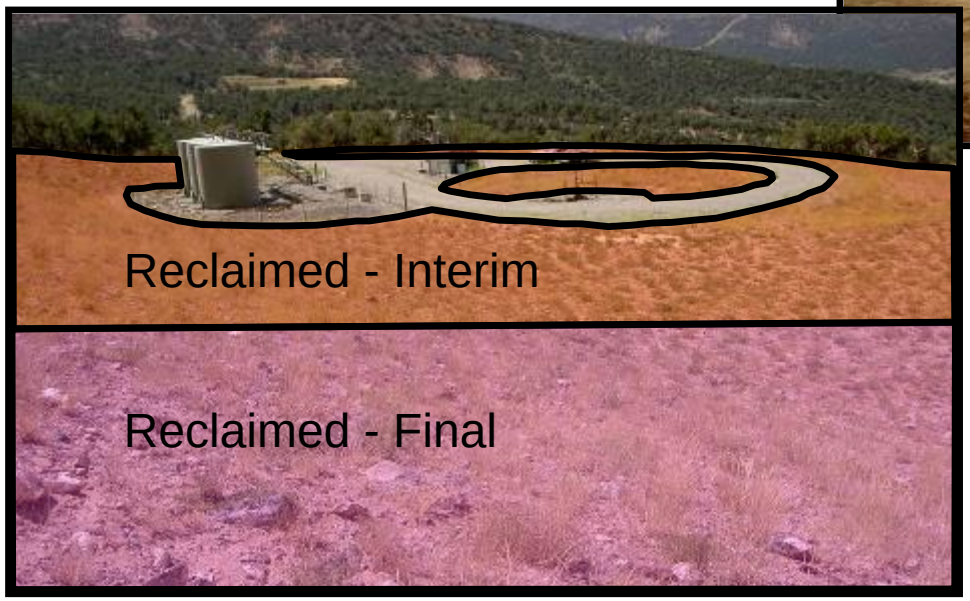
Steps:

1. Fully recontour unneeded areas to the original contour or a contour that blends with the surrounding topography;
2. Respread topsoil over entire pad;
3. Revegetate to reestablish habitat.

Interim Reclamation – Good and Bad Examples

Seed with the proper species, varieties, and amounts of seed.
The use of native species is preferred. Consider adding shrubs and forbs to the seed mixture, where appropriate, to reestablish habitat.

Good…
+ Vegetation reestablishing on pad close to facilities.
+ Concentrate facilities near the entrance road to maximize area for interim & final reclamation.



↑ Not so Good…
- Bare ground out to the rig anchors.
- Long-term loss of habitat and forage.
- Maintenance problems including mud & weeds.

Interim Reclamation of Roads

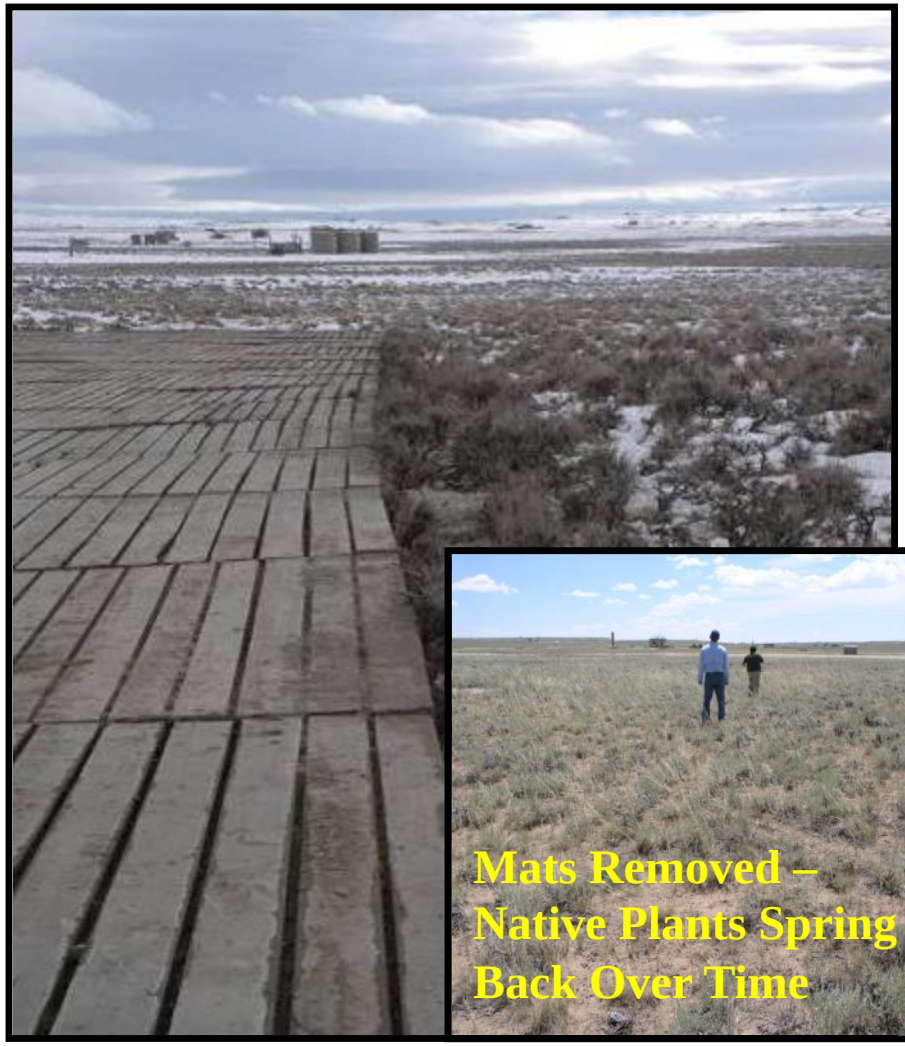
The Standard Road:
Ditches erode each time it rains. Annual maintenance including blading and weed control is required.

With Interim Reclamation:
Oversize borrow ditches covered with topsoil and seeded. Consider seeding the road surface for low use roads. Forage and habitat is partially restored. (Along high speed or high traffic roads, avoid planting species that may attract wildlife.)

Mat Pads

To Reduce Reclamation Costs & Speed Recovery

Use of Oak Mats for Pads and Roads



Directional Drilling Multiple Wells On An Individual Well Pad

Reduces the footprint of oil and gas activity in wildlife habitat.

Photo of 16 Wells on 1 Well Pad…

The result: Construction of 15 fewer well pads, 15 fewer roads, 15 fewer power lines, and reduced maintenance cost.

The feasibility of directional drilling is dependent on the subsurface geology and the depth of the hole.

Liquids Gathering Systems
Serving Offsite Production Facilities

Run liquids gathering lines (oil, gas, water, condensate) to centralized production facilities placed offsite, away from sensitive resources and habitat.

The Result:

Year-round truck traffic to each individual well is significantly reduced.

- Therefore, you may be able to use lower road standards which may result in less loss of habitat.
- There is less disturbance to wildlife because large haul trucks are not running to each well location during critical wildlife time periods to collect fluids.

A centralized production facility located outside of important wildlife habitat can service many wells and eliminate many thousands of truck trips.

Remote Telemetry Monitoring

Remote telemetry of wells and related production equipment can reduce the number of maintenance and inspection trips made during critical time periods for wildlife and result in less wildlife disturbance.

Electronic
Monitoring

Ripping-in Buried Pipelines & Utilities

Plowing and pulling pipes and lines into the ground in certain soil types will disturb much less ground and vegetation than excavating and trenching.

Plowing Method

Standard Excavating Method

For Aerial Utilities – Prevention of Avian Electrocution

1) Isolation; 2) Insulation; or 3) Deterrence

Raptors perching on power poles can be electrocuted. Perches also provide easier hunting for raptors that prey on BLM sensitive species, such as sage-grouse.

Priority Order:

1) **Isolation:** Maintaining a minimum separation spacing of 60 inches between live wires/conductors and grounded hardware/conductors.
2) **Insulation:** Covering live wires/ conductors, or grounds where separation cannot be achieved.
3) **Deterrence:** Installing perch discouragers where insulating techniques cannot be used.

For additional information, refer to: "Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006"
http://www.dodpif.org/downloads/APLIC_2006_SuggestedPractices.pdf

Minimize Noise

Noise can deter wildlife from using an area.

- Use noise reduction mufflers to comply with noise standards.
- Also, consider using earthen berms, walls, sheds, and/or distance to reduce sound levels in important habitats.

4-Side, Closed Compressor Building

Photo courtesy of: Acoustical Control Inc.

4-Side, Open Compressor Building

Development Planning

Planned Development can reduce unnecessary disturbance by reducing unnecessary roads in important habitat. A **Field Development Plan** should address sensitive area avoidance or mitigation, potential road, utility, and well locations, road classes, plans for interim and final reclamation.

None of these road shortcuts are necessary.

Plan the main road system prior to development.

(Photo Simulation)

Reduce Vehicle Traffic

In important wildlife areas and during critical wildlife use periods consider:

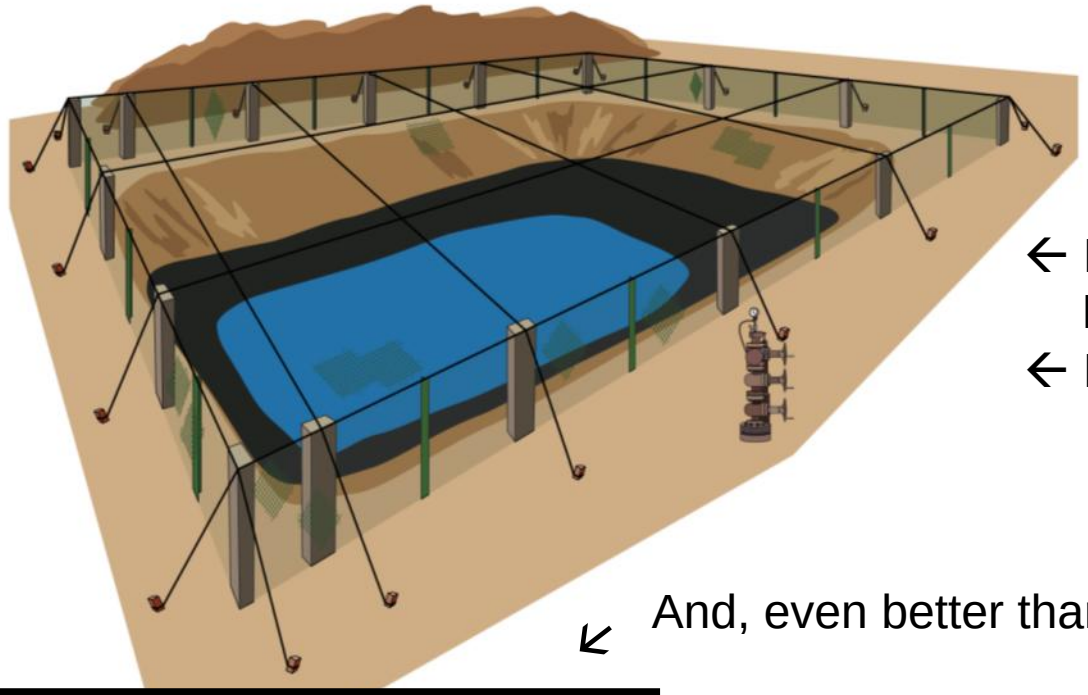
-Seasonal restriction of public vehicular access in new development areas such as dead-end, well access roads or designated portions of the field.

-Operator enforced speed limits during critical seasons.

-Using shuttle vans and buses to transport drilling rig workers and field service personnel.

Frequent vehicular use… creates dust which degrades habitat, produces noise which disturbs wildlife, causes direct mortality from collisions, and requires higher class roads to accommodate increased traffic.

Excluding Wildlife:
A Better Pit and Mud System Design



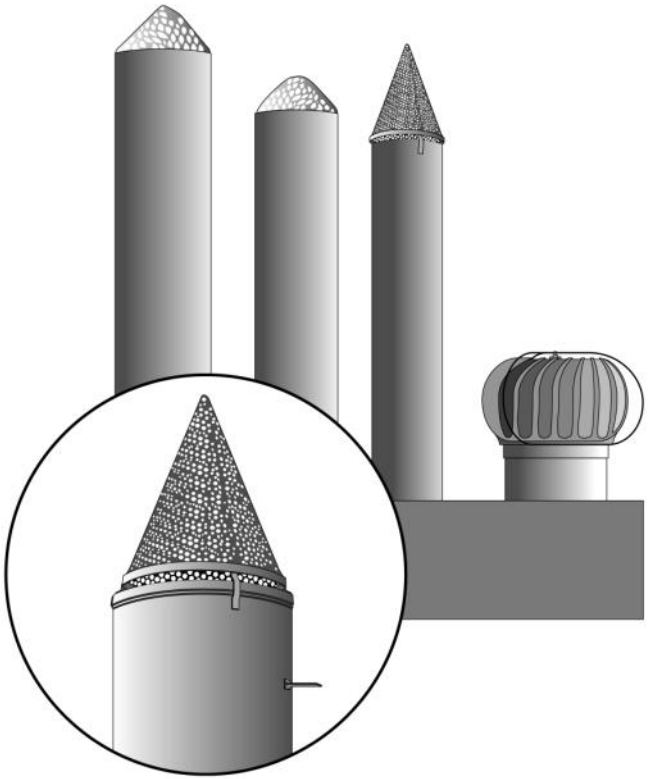
← Fencing and Netting
Keep Wildlife Out.
← Liners Keep Liquids In.

↙ And, even better than open pits…

…is the use of closed loop mud-tank systems. ↘

Excluding Wildlife: Screening or Enclosures

“Bird Cones” keep birds and bats from roosting, nesting, or sleeping in open-vent exhaust stacks.



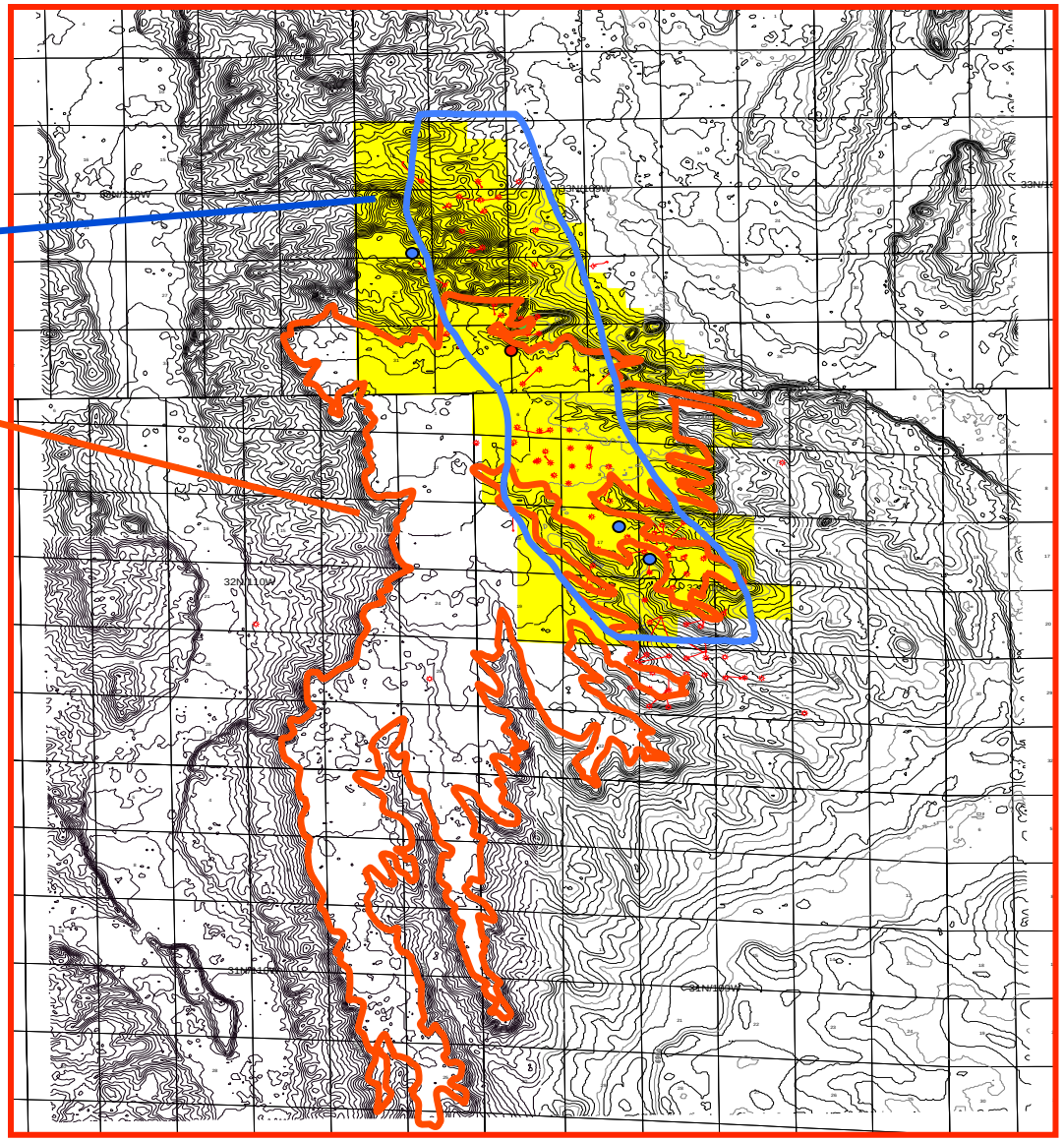
Drips from Fuel, Chemical, and Methanol Tanks should be Captured and Screened or Enclosed to Prevent Wildlife and Livestock Use.

Wildlife Escape Ramps to Prevent: Pit, Trench, and Tank Entrapment

Off-Site

Habitat Mitigation

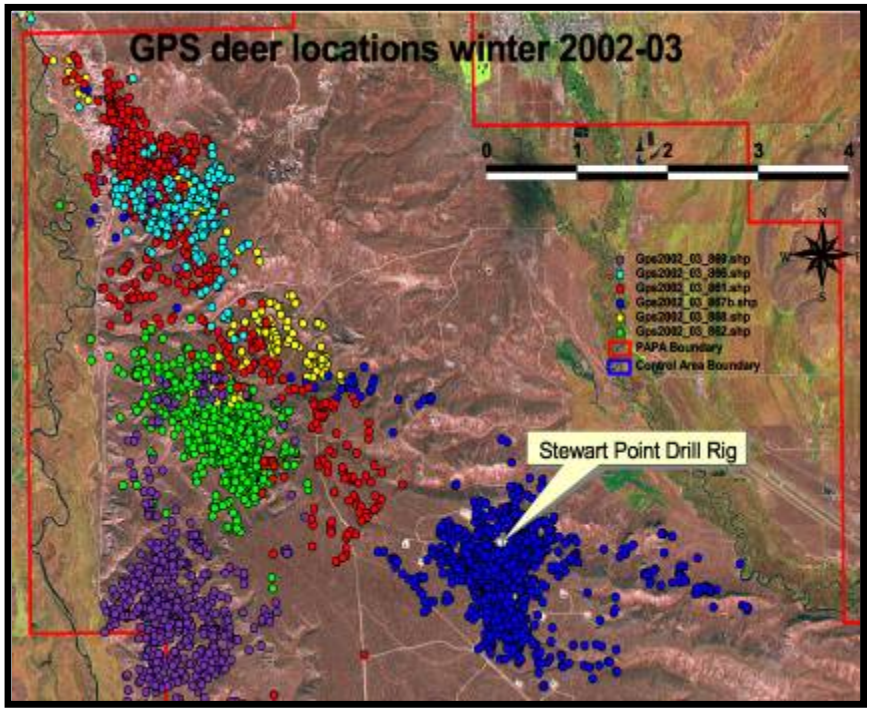
Photo of an energy production area and an area of wildlife habitat that could be improved to compensate for energy development.



In some cases, the cumulative impacts of development to wildlife habitat may necessitate taking actions to enhance local or off-site habitat. Habitat mitigation helps to reduce the impacts of habitat loss or fragmentation until full, final reclamation at the end of the oil and gas field life.

Wildlife Monitoring

Monitoring wildlife populations is critical to confirming that our mitigation is necessary and effective. It also provides the justification for taking new actions or avoiding unproductive actions.



Monitoring deer populations during winter drilling operations. Photo overlay is a summertime photo.

Each colored dot represents one deer with a GPS collar that records three times per day.

← The blue dots represent the locations of a tagged mule deer around a winter drilling operation.

Noxious and Invasive Weed Prevention

The **Number 1** tool in the fight against noxious and invasive weeds is the prompt reapplication of topsoil and reseeding and revegetation of all disturbed soils with weed-free seed. Use weed-free mulch for erosion control. Avoid unnecessarily creating or maintaining bare ground.

Noxious and Invasive Weed Prevention

When moving vehicles and machinery from areas containing noxious and invasive weeds, wash or air spray to remove weed seed.

Power-Washing

Air Spraying

Control of Noxious and Invasive Weeds

Control noxious and invasive weeds during construction, production, and reclamation using an **integrated** approach: Cultural; Chemical; Biological; Physical.

Final Reclamation

Final reclamation begins when well production ends. Ensure the site is recontoured, stable, and fully revegetated. If reclamation is done correctly, over time, the habitat will restore itself.

Remember, oil and gas development is not a permanent use of the land.

This reclaimed well pad has been recontoured (reshaped) to the pre-drilling contour, revegetated with native species, and over time will blend with the surrounding seamless landscape.

Habitat Restoration

Each species has its own habitat needs. Final reclamation practices should be focused on restoring important habitat where it exists.

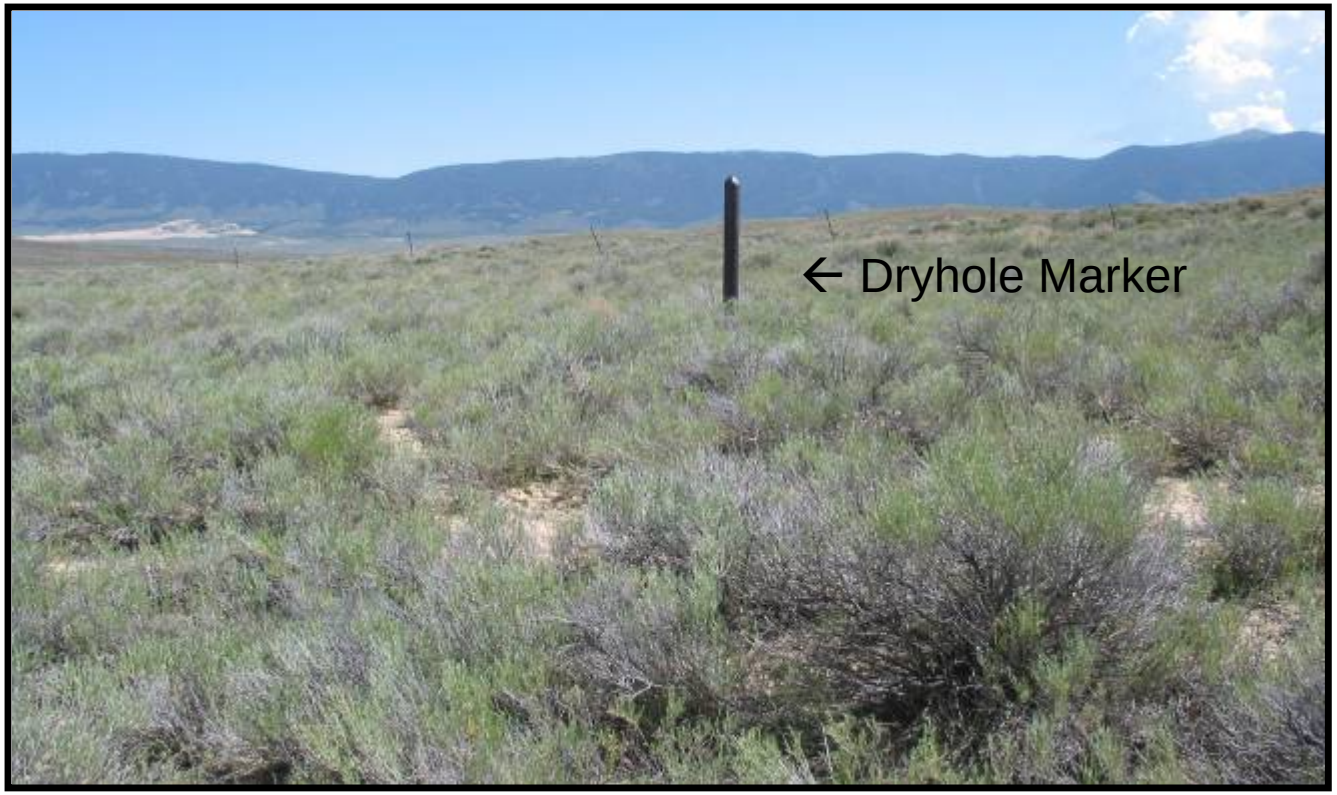
←Plant This

<u>Not</u>

This→

Final Reclamation Monitoring

Questions to ask:
Is the site stable from wind and water erosion?
Has the native plant community reestablished itself over time?
Has habitat been restored to proper species composition, size, and structure?



In this photo, the native plant community is slowly reestablishing itself on the reclaimed well pad. The dryhole marker indicates the old well location.

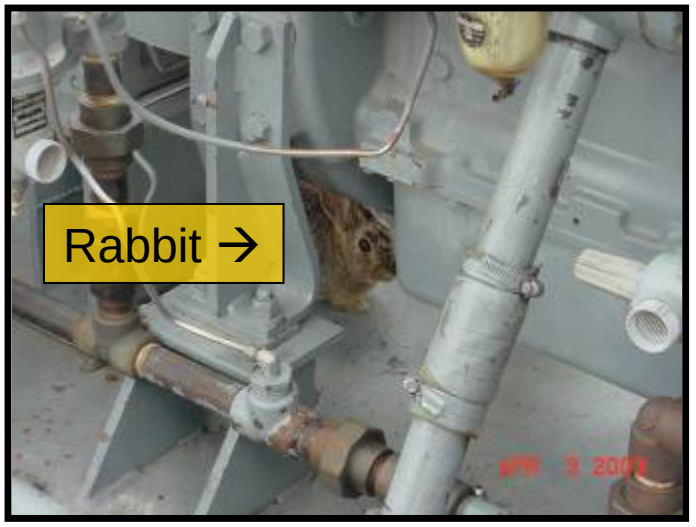
(Avoid the use of surface dryhole markers that can serve as raptor perches.)

In Summary:
Minimize the Footprint of Energy Development

To reduce wildlife habitat fragmentation, loss, and degradation, consider:

- lower class roads
- use of common corridors for roads, power, & pipelines
- smaller pads
- interim reclamation of roads and well pads
- native plant species for reclamation

Pronghorn Adjacent to Drill Rig



Deer on Well Pad

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Updated 05-09-2011

Air Resource BMPs

Best Management Practices for Fluid Minerals

Using BMPs to Reduce Emissions

Where Do Emissions Come From?

- Combustion Emissions: Include Criteria Pollutants, VOCs, GHGs, HAPs.
  - Come from: Vehicle Tailpipe Exhaust Emissions, Dehydrators, Mobile and Stationary Engines, Flaring
- Fugitive Emissions: Include Criteria Pollutants, VOCs, HAPs, GHGs
  - Equipment Leaks, Evaporation Ponds and Pits, Condensate Tanks, Storage Tanks, Windblown Dust (from Truck and Construction Activity)
- Vented Emissions: Include GHGs, VOCs, HAPs
  - Dehydrator Vents

Directional Drilling

Using directional drilling to drill multiple wells from a single well pad, rather than constructing an equal number of separate roads and well pads.

Sixteen Wells on this Well Pad

Efficiency Drilling Rig

Benefits –

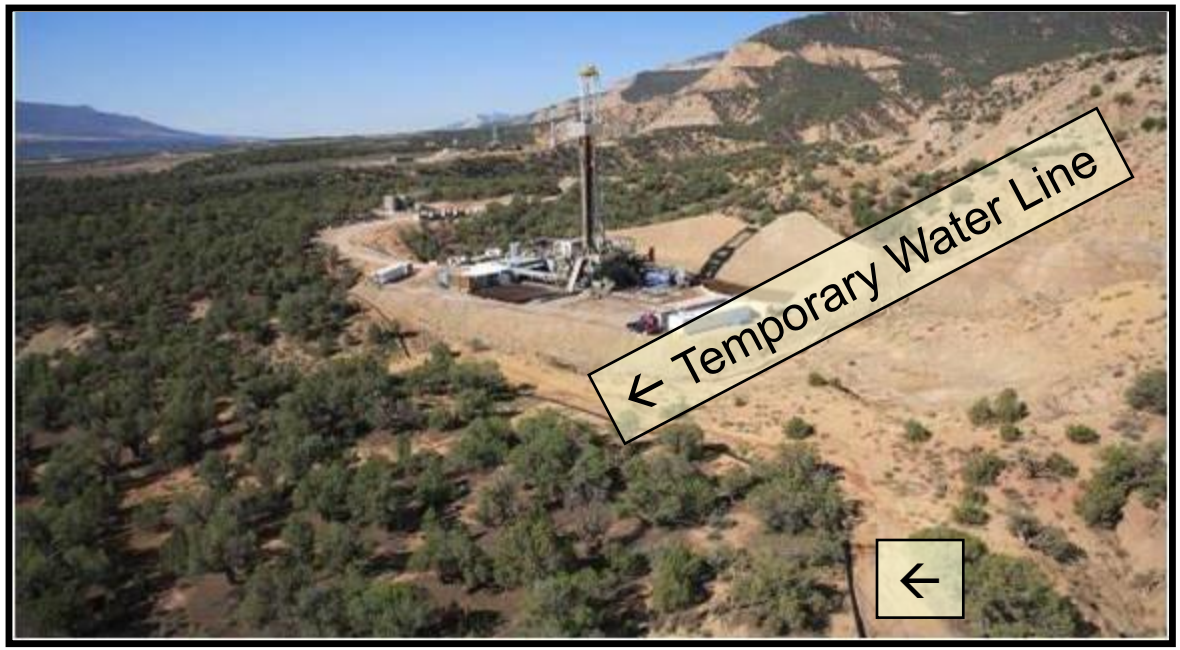
- Reduces road & pad construction-related dust and emissions.
- Reduces road network.
- Reduces truck traffic dust and emissions.

Centralized Water Storage and Delivery

Using centrally stored water that is piped to the well pads and fracturing facilities through a temporary, plastic, surface line.

Benefits –

Reduces Water Hauling Truck Trips and Decreases Associated Dust and Tailpipe Emissions

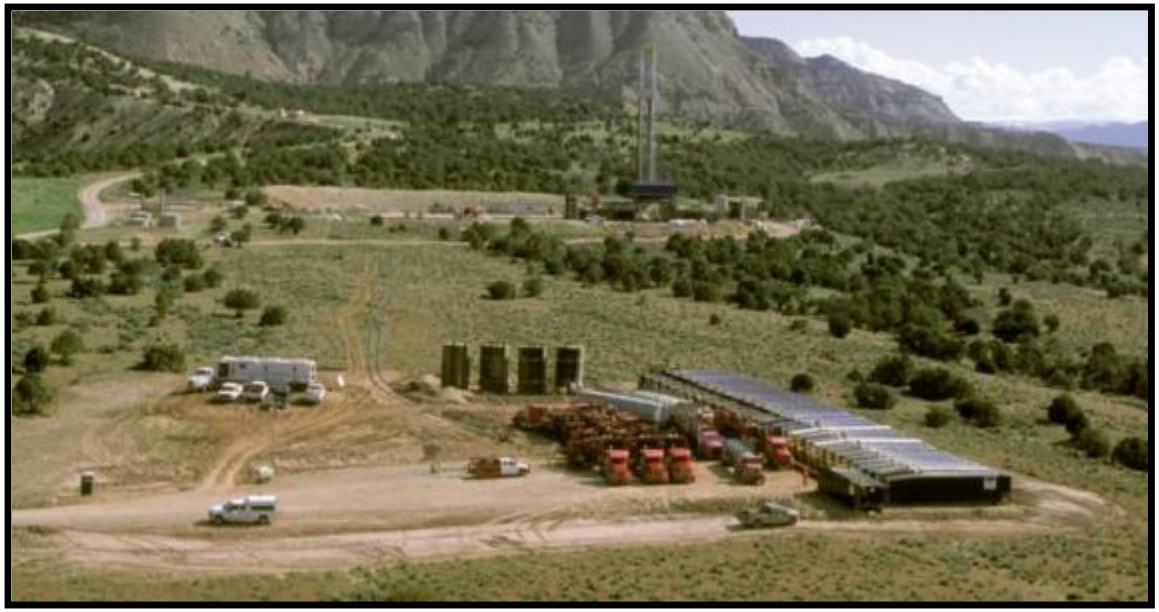


Centralized Fracturing

Using centralized fracturing pads with hard-line frac pipes, some running over one mile, that can serve many well pads - representing hundreds of wells in all.

Benefits –

Reduces Water Hauling Truck Trips and Decreases Associated Dust and Tailpipe Emissions



Off Site Centralization of Production and Use of Liquids Gathering Systems

Using Liquids Gathering Systems to collect and pipe produced fluids from each remote well location to a Centralized Production and Collection Facility situated more closely to a major county or State highway.

Benefits –

Centralization creates fewer emissions sources and makes it more efficient to control emissions. Reduces Haul Truck Trips and Decreases Associated Dust and tailpipe emissions.

Cleaner Diesel Power

Moving toward cleaner diesel engines, Tier 2 → 3 → 4

(Tier 4 is cleaner than Tier 2.)

Tier 4 diesel engine standards are being phased in from 2011 through 2014 by manufacturers of new engines.

A Tier 2 diesel engine powers an electric motor to drill this well.

www.epa.gov/nonroad-diesel/regulations.htm

Natural Gas Power

Natural gas powered engines are typically cleaner than diesel engines and are the approximate equivalent of Tier 4 diesel engines.

Natural gas fueled engines power electric motors to drill this well.

Venting

- Releases methane, a greenhouse gas (GHG) that has 25 times more global warming potential than CO_2

  Intergovernmental Panel on Climate Change
  http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch02.pdf page 212

- Emits Volatile Organic Compounds (VOCs) which contribute to ozone formation

- Emits Hazardous Air Pollutants (HAPs) such as Benzene, Toluene, and Xylene in larger quantities than flaring

- Wastes valuable natural gas resources

Flaring

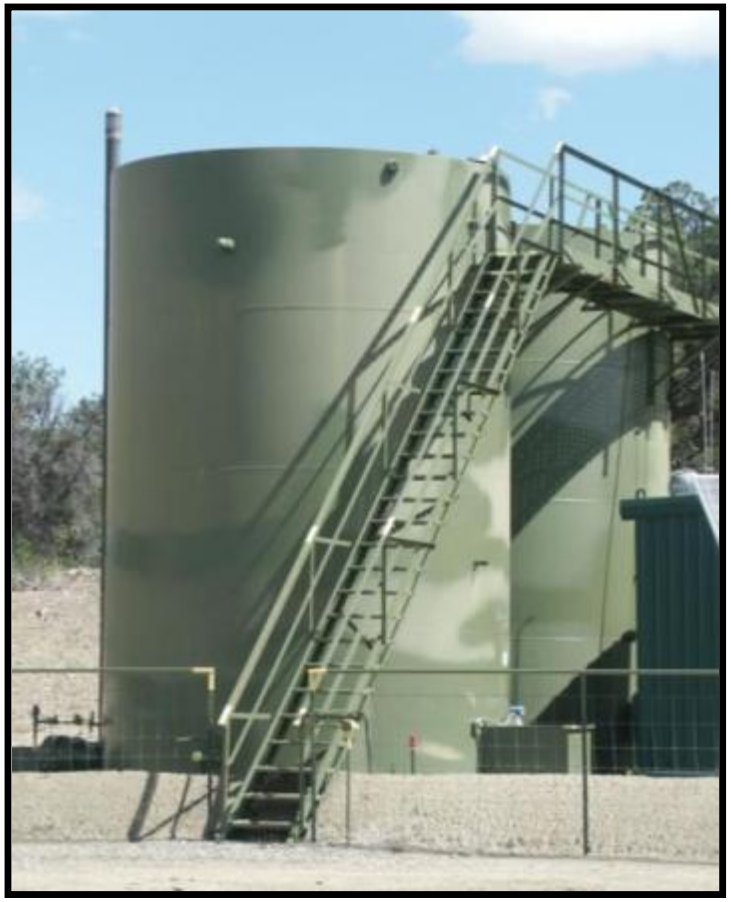
- Reduces Methane GHG emissions, however…
- Combustion emissions include NOx, CO, VOCs, and $PM_{2.5}$, which can pose visibility and health problems, and CO_2 (a less potent GHG). NOx and VOCs contribute to ozone formation.
- Wastes valuable natural gas resources

Flaring natural gas is usually a better alternative than venting gas; however, potential fire hazards, impacts to visibility, and citizen concerns may preclude the use of flaring at certain sites.

More Information at www.epa.gov/gasstar/documents/installflares.pdf

Capturing VOCs

Using enclosed tanks instead of open pits to reduce fugitive VOC emissions.



Vapor Recovery Units

Using vapor recovery units on oil, condensate, and produced water storage tanks reduces fugitive VOCs and recovers BTU-rich vapors for sale or use on site.

More information at www.epa.gov/gasstar/documents/ll_final_vap.pdf

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