



Stormwater Management Plan For Construction Activities

Rangely Weber Sand Unit
Chevron U.S.A. Inc.
Rio Blanco County, Colorado

**ADMINISTRATIVE LOG
CHEVRON USA, INC.
RANGELY WEBER SAND UNIT**

Date	Training, SWMP Revisions or Updates	Comments
Aug-2009	Begin permit/SWMP	
Jan-2010	SWMP revisions	
Mar-2012	SWMP re-write	SWMP into new format (administrative log added)
Jul-2013	SWMP updates/revisions	SWMP administrator updated; Appendix C changed to BLM Gold Book Chapters 4 & 6; location of site maps/ inspection reports updated; permit documents added to Appendix A; minor revisions throughout.
Sep-2013	SWMP revision	SWMP administrator revised.
Oct-2013	SWMP updates/revisions	Spill response procedures updated/revised, and spill response reference materials added as Appendix E.
Jul-2015	SWMP updates/revisions	New project site overview maps created with updated disturbances. Disturbed acreage updated. Phased BMP Installation, Spill Response, and Dewatering sections revised. Minor revisions throughout SWMP.
Aug-2016	SWMP updates	Permit documents added to Appendix A (contact change and disturbance removals). Signatory changed to Nick Moschetti; local SWMP administrator changed to Mike Haub. Disturbances updated on overview maps. Disturbed acreage reduced to 450 acres.
Apr-2017	SWMP updates	SWMP narrative updated to reference StormPro database for site maps and inspection reports.
Jun-2017	SWMP updates	Twelve pipelines and three finally reclaimed well pads removed from permit/SWMP coverage. Removal package added to Appendix A. Disturbances updated on overview maps. Disturbed acreage reduced to approx. 400 acres.
Aug-2017	SWMP updates	Thirteen pipelines and ten finally reclaimed well pads removed from permit/SWMP coverage. Removal package added to Appendix A. Disturbances updated on overview maps. Disturbed acreage reduced to approx. 350 acres.

STORMWATER MANAGEMENT PLAN FOR CONSTRUCTION ACTIVITIES

RANGELY WEBER SAND UNIT

Rio Blanco County, Colorado

Prepared For:



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Project # 009-0944

**Revised:
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CHEVRON U.S.A. INC., Certification

Stormwater Management Plan for
Rangely Weber Sand Unit
Rio Blanco County, Colorado

Olsson Associates has prepared this Stormwater Management Plan for Construction Activities for Chevron U.S.A. Inc. for Rangely Weber Sand Unit located in unincorporated Rio Blanco County, Colorado.

"I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature: _____

Name: Nick Moschetti

Title: Superintendent

Date: _____

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Appendix B	NRCS Soil Unit Map, Soil Descriptions, and Ecological Site Maps & Descriptions
Appendix C	BLM Gold Book, Chapters 4 & 6
Appendix D	Best Management Practice (BMP) Manual
Appendix E	Environmental Spill Reporting Brochure, COGCC Revised Rule 906, SPCC Plan Narrative

INTRODUCTION

This Stormwater Management Plan (SWMP) for Construction Activities is written to comply with the Colorado Department of Public Health and Environment's (CDPHE) General Permit No. COR-030000, issued on July 1, 2007 and administratively continued on June 30, 2012 to remain in effect until the new permit being developed by the Water Quality Control Division is issued and effective, and with related U.S. Environmental Protection Agency (USEPA) National Pollutant Discharge Elimination System (NPDES) stormwater regulations. This SWMP addresses construction activities associated with Chevron U.S.A. Inc. (Chevron)'s petroleum exploration and production activities at the Rangely Weber Sand Unit (RWSU), in Rio Blanco County, Colorado. A copy of the certification to discharge (COR-03F434), the Colorado Discharge Permit System (CDPS) general permit (COR-030000), and any related documents can be found in **Appendix A**.

This SWMP is intended to be revised as necessary to address planned developments, new disturbances, and other changes required to manage stormwater and protect surface water quality. These changes shall be documented in the Administrative Log located at the front of this document.

Stormwater Runoff Permitting Requirements

The Federal Clean Water Act [Section 402(p)] requires that discharges of pollutants to waters of the U.S. from any point source be regulated by NPDES permits. In November 1990 the EPA published final regulations that established application requirements for stormwater associated with construction activity for soil disturbances of 5 acres or more be regulated as an industrial activity and covered by an NPDES permit. In December 1999 the EPA published final Phase II NPDES regulations that established application requirements for stormwater associated with construction activity for soil disturbances to be regulated as an industrial activity and covered by an NPDES permit. These regulations became effective July 1, 2002.

On June 30, 2005, Colorado stormwater regulations went into effect to require CDPS permits for stormwater discharges from construction activities for oil and gas activities (1 acre or greater). Federal permit coverage for these discharges was conditionally exempted from the Federal Clean Water Act by the 2005 Federal Energy Bill. On February 1, 2006, the CDPHE issued a letter clarifying that the CDPHE Water Quality Control Commission decided to maintain the existing requirements for stormwater permitting for oil and gas construction sites greater than 1 acre.

1. CONSTRUCTION SITE DESCRIPTION

Chevron is undertaking a number of upgrade projects in the RWSU in Northwest Colorado. The RWSU is approximately 4 miles wide (north to south) and 10 miles long (east to west), and is located in Rio Blanco County in Township 1N, Ranges 101W and 102W and Township 2N, Ranges 101W, 102W, and 103W, 6th Principle Meridian. The project site is 19,143 acres and includes well pads and collection stations, pipelines, and site-specific access roads. The town of Rangely, Colorado is the nearest population center. See **Figures 1 through 4** for a permit area location map.

1.A Nature of Construction Activity

The scope of this project includes installation of flowlines to newly completed wells and upgrades to existing sections of water injection pipelines throughout RWSU. The upgrade will eliminate existing lines, optimize production, and reduce the risk of produced water spills by replacing aging

sections of the system. These projects are various in nature and purpose, and may include, but are not limited to:

- Drilling and re-drilling wells to enhance production, which includes the construction of well pads, vehicle access roads, and flow lines.
- Pipeline repair, replacement, and new installations, including water gathering, gas gathering, crude gathering, water injection, gas injection, and liquid hydrocarbon product lines. These projects often involve stream crossings.
- Surface facility upgrades and installation, which may include the installation of tanks, separators, heated treaters, valve manifolds, or other equipment typical of oil production activities.
- Road repair and construction, which may include the repair, replacement or new installation of bridges, culverts, and other structures associated with the construction of low volume roads.
- Location reclamation of past projects, including pit remediation, well location reclamation and other environmental mitigation measures.

Construction at RWSU will be performed using conventional cut and fill earthmoving techniques and trenching. The total estimated disturbance for the pads, pipelines, and access roads currently active under this SWMP is approximately 350 acres. Reserve pits may be constructed for use during operations to contain drilling fluids and cuttings. The pits will be designed, constructed, and reclaimed according to COGCC requirements.

In areas that are disturbed by construction, topsoil will be stripped and stockpiled near the site. All brush, limbs, and other woody material will be stockpiled separately from the topsoil. Soil materials will be managed so that erosion and sediment transport are minimized. Nearby drainages will be protected by appropriate measures.

If a well is not productive, it will be plugged and abandoned in accordance with COGCC rules and the pad area will be reclaimed to approximate pre-construction contours and seeded. Construction and reclamation activities will also be completed, if and where appropriate, in accordance with BLM Gold Book Chapters 4 and 6, which are included as **Appendix C**.

1.B Sequence of Construction Activities

The development of an oil well is generally accomplished in six work phases. They include: Access Road and Pad Construction, Well Drilling, Well Completion, Production, Interim Reclamation, and Final Reclamation. Each work phase is briefly discussed below and the best management practices (BMPs) are discussed in Section 3.C.

Access Road and Pad Construction

Pad and access road construction will be performed using traditional cut and fill construction. Size and maintenance requirements for each access road are based on road location and traffic level. Reserve pits may be constructed on the pads at this time to store certain fluids and solids during drilling and completion operations. No fluids or solids, excluding any accumulated stormwater, will be stored in the reserve pits during this phase.

Basic construction activities that are conducted during this phase include clearing and grubbing, segregation of topsoil for use in reclamation, grading and excavation, compaction, final grading and contouring, and installation of surfacing materials such as gravel. To the extent possible, BMPs that will be utilized to control stormwater throughout the life of the facility will be constructed during this phase.

Sediment discharge is the main potential pollutant of concern during access road and pad construction. No chemicals or fuels will be stored on site during this phase; however, attention will be paid to the potential for leaks that might occur during the use of construction equipment.

Well Drilling

The Well Drilling phase includes the drilling of one or more wells at each location. Activities associated with the drilling phase may include:

- Mobilization of the drilling rig and associated equipment, including generators and drilling-mud handling equipment. In some instances a smaller drilling rig may be used to drill the initial stages of each well prior to the larger drilling rig mobilizing to the location
- Installation of storage, office and housing trailers
- Storage of down hole chemicals, fuels and lubricants
- Installation of potable water tanks and sewage-handling equipment (e.g., portable toilets or sewage vaults)
- Well drilling activities including the installation and cementing of well casing
- Demobilization of the drilling rig and all other equipment at the completion of this phase

Sediment discharge, unused and used chemicals, and drilling water/mud are potential pollutants of concern during this phase of construction. Drilling mud and water will be used to maintain appropriate down hole pressures and lubrication. Unused fresh water and mud chemicals will be stored on the pad. Used materials will either be discharged to the reserve pit or captured in tanks during closed-loop drilling processes. Petroleum products are used for the duration of the drilling process to fuel or lubricate equipment and include: fuel, gear oil, hydraulic oil, brake fluid, and grease. Materials to be used to cement casing placed in the well may also be stored and prepared on location or may be transported to the site.

Procedures will also be implemented for prompt containment and remediation of any spills that may occur during the drilling phase. These procedures are outlined in Chevron's RWSU Spill Prevention, Control and Countermeasures (SPCC) plan (**Appendix E**).

As equipment is demobilized at the completion of this phase, the well pad and surrounding areas will be carefully inspected to identify any spills or leaks that may have occurred so that those areas can be remediated prior to initiation of the well completion phase.

Well Completion

The Well Completion phase may include hydraulic fracturing (fracking), cementing, and other processes that stimulate the well and prepare it for production. The basic activities that are conducted during this phase include:

- Mobilization of equipment required for well completion
- Storage of down hole chemicals, fuels and lubricants
- Installation of potable water tanks and sewage-handling equipment (e.g., portable toilets or sewage vaults) or continued maintenance of such equipment installed during the drilling phase
- Fracking and other well-stimulation processes

- Drill out of any plugs placed during well completion with a work-over rig
- Flowback of the well to remove frac water, sand and other impurities
- Demobilization of equipment when this phase has been completed

Several temporary facilities/structures will be placed on site during this phase. These will include: frac trucks, storage and office trailers, generators, and frac tanks. During completions, certain chemicals may be used to stimulate the formation for the extraction of oil. Unused water and chemicals will be stored on the pad. Used water will be stored in the reserve pit, recycled, or used in other operations.

Sediment discharge, unused and used chemicals, and frac water are potential pollutants of concern during this phase of construction. As equipment is demobilized at the completion of this phase, the well pad and surrounding areas will be carefully inspected to identify any spills or leaks that may have occurred so that those areas can be remediated prior to initiation of the production phase.

Production

The Production phase includes the installation of long-term facilities such as permanent well heads, storage tanks, oil and natural gas processing equipment, flow measurement equipment, and any associated flow lines needed to produce oil from the formation. Pipeline installation or any required maintenance work is generally accomplished by trenching. The area of disturbance for each pipeline project is determined by location, pipeline size, and the scope of the work being done.

Sediment discharge, produced fluids, and small amounts of equipment lubricant, fuel, corrosion inhibitors or other chemicals are potential pollutants of concern during this phase.

Interim Reclamation

The Interim Reclamation phase includes the contouring of the majority of the pad to a smaller area. The reduced area will be utilized for long-term production and ongoing routine maintenance of the well(s). In general, this phase includes contouring of the site, spreading of topsoil on contoured areas and seeding those areas.

Sediment discharge, produced fluids and small amounts of equipment lubricant, fuel, corrosion inhibitors or other chemicals are potential pollutants of concern during this phase of construction.

Permit coverage may be inactivated for oil and gas construction sites even if stabilized unpaved surfaces exist and/or disturbed land that has been restored to cropland remains non-vegetated, as long as construction activities have been completed and all other disturbed areas are re-vegetated.

Final Reclamation

When the production of a well is exhausted, it will be abandoned. Upon well abandonment each borehole will be plugged, capped, and all surface equipment will be removed. Subsurface pipelines will be removed to specified locations or abandoned in place as per COGCC Rule 1103.

The pad area will be reclaimed by contouring disturbed soils to conform to the surrounding terrain, by redistributing the stockpiled topsoil, seeding of disturbed soil areas in order to reestablish cover vegetation, and by construction of any permanent erosion and sediment control structures as needed.

Sediment discharge is the main potential pollutant of concern during this phase. No chemicals or fuels will be stored on site during this phase; however, attention will be paid to the potential for leaks that might occur during the use of construction equipment.

1.C Estimate of Total Area of Site and Area to be Disturbed

The total project site is 19,143 acres. The total disturbance area within the project site is approximately 350 acres in size. As new sites are added to the project site, the SWMP will be updated to reflect the new disturbances.

1.D Soil Data and Erosion Potential

Runoff characteristics are based primarily on site topography, soil type, and vegetative cover. The major soil types for these areas are: Chipeta silty clay loam, 3 to 25 percent slopes; Billings silty clay loam, 0 to 5 percent slopes; Chipeta-Killpack silty clay loams, 3 to 15 percent slopes; Chipeta silty clay loam, 3 to 25 percent slopes, eroded; and Billings-Torrifluvents complex, gullied, 0 to 5 percent slopes. The major soil types in the project site are well drained soils with a low to very high (~4.5 inches to ~20.0 inches) water holding capacity.

A Natural Resources Conservation Services (NRCS) unit map and soils description for the dominant soils in the project site is provided in **Appendix B**.

The K-factor approximates soil detachment due to runoff and raindrop impact. Lower k-Factor values (0.1 – 0.17) indicate less susceptibility to sheet and rill erosion, while higher k-Factor values (>0.30) indicate greater susceptibility to erosion.

The Hydrologic Group describes soil and soil units with the potential for runoff under similar storm and cover conditions. Group A has a high infiltration rate and a corresponding lower potential for runoff, while Group D has low infiltration rates due to finer soil texture or a high water table, giving them a high potential for runoff.

The average annual precipitation for the RWSU is 0 to 15 inches (Western Regional Climate Center).

Table 1 shows the soils data and erosion potential for the soil types in the project site, listed by acreage of the soil survey areas of interest (AOIs). The AOIs encompasses slightly more acreage than the actual project site.

Table 1 - Soils Data and Erosion Potential

Soil Name	Hydrologic Group	K-factor	Representative Value			Combined Acreage in AOIs
			% Sand	% Silt	% Clay	
Chipeta silty clay loam						11693
Chipeta	D	0.32	17.3	47.7	35.0	
Billings silty clay loam						3880
Billings	C	0.49	6.9	62.1	31.0	
Chipeta-Killpack silty clay loams						2311
Chipeta	D	0.32	17.3	47.7	35.0	
Killpack	C	0.49	6.9	62.1	31.0	
Billings-Torrifluvents complex						1122
Billings, gullied	C	0.49	6.9	62.1	31.0	

Torrifluvents, gullied	B	0.32	42.1	37.9	20.0	
Turley fine sandy loam						684
Turley	B	0.24	63.1	19.4	17.5	
Badland						658
Badland	D	-	-	-	0.0	
Cliffdown-Cliffdown variant complex						542
Cliffdown	B	0.37	45.7	41.8	12.5	
Cliffdown variant	D	0.32	42.1	37.9	20.0	
Colorow sandy loam						542
Colorow	B	0.24	67.4	19.6	13.0	
Torriorthents-Rock outcrop complex						433
Torriorthents	D	0.43	44.3	40.7	15.0	
Rock outcrop	D	-	-	-	0.0	
Rock outcrop						312
Rock outcrop	D	-	-	-	0.0	
Uffens loam						302
Uffens	B	0.37	42.1	37.9	20.0	
Kinnear fine sandy loam						233
Kinnear	B	0.28	63.1	19.4	17.5	
Water						172
Water	-	-	-	-	-	
Fluvaquents, frequently flooded						122
Fluvaquents, frequently flooded	B/D	0.2	65.1	14.9	20.0	
Nihill channery sandy loam						28
Nihill	B	0.2	67.9	19.6	12.5	
Torrifluvents, gullied						8
Torrifluvents, gullied	B	0.32	42.1	37.9	20.0	
Barcus channery loamy sand						7
Barcus	A	0.1	83.5	9.0	7.5	

1.E Vegetation Description and Estimate

The project site is in a high elevation desert vegetated mainly by shrubs including mat saltbush, shadscale, Gardner saltbush, winterfat, and bud sagebrush; the warm season rhizomatous grass galleta; and cool season bunchgrasses including Indian ricegrass, needleandthread, bottlebrush squirreltail, and salina wildrye; with some forbs and other grasses. Ground cover rarely exceeds 15 to 20 percent, but will vary from site to site. NRCS Ecological Site maps and descriptions are included in **Appendix B**.

1.F Potential Pollution Sources and Locations

The potential pollution sources for each phase of construction are briefly discussed in Section 1.B Sequence of Construction Activities. They are discussed in more detail in Section 3.B Potential Pollutant Sources. The locations of all potential pollution sources are shown on the site maps.

1.G Non-Stormwater Discharges

Non-stormwater discharges are not expected from the construction project.

1.H Receiving Waters

The RWSU lies within the Coal Oil Basin, which generally drains northwest to southeast into Stinking Water Creek near the middle of the field. Stinking Water Creek drains into the White River that borders the southeast corner of the field. The White River runs southwest joining the Green River in eastern Utah. The Green River drains into the Colorado River in southeastern Utah.

Most surface flow goes into Stinking Water Creek before entering the White River. Because of their proximity to the White River, the surface flow on a small number on the southeast end of the field naturally drains via unnamed drainage paths directly into the White River. **Figures 1 through 4** show the receiving waters for the project site.

2. SITE MAP(S)

The site maps for the RWSU will be maintained within a StormPro Max online stormwater management database. The maps will be regularly updated to reflect all changes to the sites.

2. A Construction Site Boundaries

For an accurate representation of the construction site boundaries, refer to the site maps.

2. B Areas of Ground Disturbance

For an accurate representation of the areas of ground disturbance, refer to the site maps.

2. C Areas of Cut and Fill

For an accurate representation of the areas of cut and fill, refer to the site maps.

2. D Storage Areas

For an accurate representation of the storage areas, refer to the site maps.

2. E Location of Asphalt and Concrete Batch Plants

Asphalt or concrete batch plants are not anticipated within the project site, but, if used, will be included on the site maps.

2. F Locations of Structural BMPs

For an accurate representation of the location of structural BMPs, refer to the site maps.

2. G Locations of Non-Structural BMPs

For an accurate representation of the location of non-structural BMPs, if applicable, refer to the site maps.

2. H Locations of Springs, Streams, Wetlands and Other Surface Waters

For an accurate representation of the location of springs, streams, wetlands, and other surface waters, refer to **Figures 1 through 4**.

3. STORMWATER MANAGEMENT CONTROLS

3.A Stormwater Administrator

The SWMP Administrators for Chevron - RWSU are:

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The SWMP Administrator is responsible for developing, implementing, maintaining and revising the SWMP as necessary. The administrator may delegate the SWMP inspections and maintenance of records to qualified personnel.

3.B Potential Pollutant Sources

Disturbed and stored soils: The construction activities will involve soil disturbances and stockpiling. Clearing, grading, and otherwise altering previously undisturbed land can greatly increase the rate of soil erosion over pre-disturbance rates. The resulting sediment can impact the water quality of receiving streams.

Vehicle tracking of sediments: Vehicles will be accessing the sites up until the Final Reclamation phase. This also has the potential to facilitate the movement of sediment off site.

Management of contaminated soils: If a spill of any type were to occur, the impacted soil would become a potential stormwater pollutant.

Loading and unloading operations: The sites may have tanks for the storage of fuels or production-related liquids. The presence of such tanks would require loading and unloading of the tanks.

Outdoor storage activities: The construction contractor will maintain a laydown or staging area for equipment and material storage on site. Depending on the work phase of the site, chemicals and/or other drilling materials may be stored on site, and tanks used to store fuels or production-related liquids may be present. These storage activities are discussed in more detail in 1.B Sequence of Construction Activities.

Vehicle and equipment maintenance and fueling: During construction, it is possible that equipment will be maintained or fueled on site. On-site maintenance and fueling could potentially result in leaks or spills of fuel, gear oil, hydraulic oil, brake fluid, or grease.

Significant dust or particulate generating processes: Construction activities and vehicle traffic to and from the sites could potentially generate dust.

Routine maintenance activities: The use of fertilizers or weed killers is possible at the sites in order to achieve successful revegetation of disturbed areas. See also “vehicle and equipment maintenance and fueling” above.

On-site waste management practices: Trash receptacles will be located on site to contain construction-related or other trash or debris. Used drilling mud and water will be discharged to reserve pits, or captured in tanks during closed-loop drilling processes. Portable toilets may be utilized on site.

Concrete truck/equipment washing: Concrete truck or equipment washing is not anticipated.

Dedicated asphalt and concrete batch plants: Dedicated asphalt and concrete batch plants are not anticipated.

Non-industrial waste sources: All project phases involve workers on site. This can generate personal and work-related trash and debris, and may also necessitate the use of portable toilets. Clearing operations may also generate waste in the form of slash (trees, brush, etc.).

Other areas or procedures: No other areas or procedures where spills can occur are anticipated at this time.

The locations of potential pollutant sources are shown on the site maps. BMPs utilized to address potential pollutant sources are described in Section 3.

3.C BMPs for Stormwater Pollution Prevention

This section describes the BMPs that will be used at the RWSU for stormwater pollution prevention. Chevron’s BMP Manual containing the BMPs which may be implemented is included in **Appendix D**. BMPs may be added or removed from the manual to accommodate changes in site conditions and activities at the RWSU.

Run-on protection and run-off controls will be installed prior to the beginning of construction activities, as practicable, with consideration given to worker safety and site access. Additional structural and non-structural BMPs will likely need to be installed during and following construction.

3.C.1 Structural Practices for Erosion and Sediment Control

Descriptions, design and installation practices, and maintenance and removal considerations for the structural BMPs available for use can be found in the BMP Manual. The location of all structural BMPs will be found on the site maps.

3.C.2 Non-Structural Practices for Erosion and Sediment Control (includes wind erosion/dust control)

Descriptions, design and installation practices, and maintenance and removal considerations for the non-structural BMPs available for use can be found in the BMP manual. The location of non-structural practices will be found on the site maps if applicable.

3.C.3 Phased BMP Installation

Construction activities will occur at individual, smaller (less than 1 acre to a few acres) locations within the project site over many years. BMP implementation will be coordinated with the various stages of construction for each area of disturbance. Run-on protection and run-off controls will be installed prior to earth disturbing activities in an area where practicable, with consideration given to worker safety and access. Additional structural BMPs will likely be installed during construction. As portions of the site are completed and previously disturbed areas are stabilized or BMPs are no longer needed, the BMPs will be removed.

Permanent or temporary stabilization measures for all slopes, channels, ditches, disturbed land area, and soil stockpiles will be implemented as soon as practicable after final grading or the final ground disturbance has been completed. When it is not possible to permanently stabilize a disturbed area after a disturbance has been completed or where significant ground disturbance activity ceases, temporary erosion control measures will be implemented as soon as practicable. **Table 2** below outlines the typical BMP phasing to take place at each area of disturbance.

Table 2 – BMP Phasing

Project Phase	BMPs to be implemented during each phase
Pre-Disturbance/Site Preparation	<ul style="list-style-type: none"> • Limit access to areas that are not to be disturbed. • Install vehicle tracking controls (if/where needed). • Install planned run-on/run-off controls prior to disturbance where possible.
Construction (initial construction, contouring for interim or final reclamation, or other disturbances)	<ul style="list-style-type: none"> • Locate soil stockpiles within planned work areas and with perimeter BMPs. • Continue installing all planned BMPs as soon as practicable for each area. • Leave disturbed area of site in a surface roughened condition when feasible. • Protect, inspect and repair BMPs.
Post-construction	<ul style="list-style-type: none"> • Inspect, maintain, and repair BMPs installed during previous phases. • Perform seeding and mulching or the installation of erosion control blankets where applicable.
Final Stabilization (interim or final reclamation)	<ul style="list-style-type: none"> • Inspect, maintain, and repair BMPs installed during previous phases. Monitor revegetation and re-seed areas if needed. • Remove temporary BMPs when areas are stabilized.

3.C.4 Materials Handling and Spill Prevention

Materials and spills will be handled as described in Chevron's Spill Prevention, Control, and Countermeasure (SPCC) plan and in this section.

Petroleum Product Management

Pollutants from petroleum products used during construction activities adhere easily to soil particles and other surfaces. In the case of a spill or leak, soils contaminated with petroleum products will be contained, and remediated onsite or removed to a proper disposal site.

Use of secondary containment will reduce the risk of spills or leaks contacting the ground, including during loading and unloading operations. The use of drip pans will reduce the likelihood of spills or leaks contacting the ground during vehicle or equipment maintenance or fueling. Proposed soil erosion and sediment control practices will also aid in the retention of spills or leaks.

Oily wastes such as crankcase oil, cans, rags, and paper containing oils will be placed in proper receptacles and disposed of or recycled. Routine daily inspections will be conducted to identify leaks from equipment and vehicles and if needed corrective actions will be implemented.

The following guidelines for storing and managing petroleum products will be implemented:

- All product containers will be clearly labeled
- Drums (if present) will be kept within secondary containment, and may also need to be kept off the ground. Lids for drummed materials will be securely fastened.
- Fuel tanks will be stored within secondary containment
- Emergency spill response procedures will be available on site. Persons trained in handling spills will be on call at all times
- Spill response equipment and materials (absorbent, shovels, etc.) will be easily accessible. Spills will be immediately cleaned up and contaminated materials will be properly stored on site until they can be disposed of in accordance with applicable regulations
- Storage areas and containers will be regularly monitored for leaks and repaired or replaced as necessary. Contractors and subcontractors should be reminded about proper storage, handling and transferring of petroleum products or other hazardous materials during safety meetings.

Other Material/Chemical Product Management

Any other materials that could contribute pollutants to runoff shall be stored in original packaging and/or otherwise covered, and may also need to be kept off the ground, to ensure that the material does not interact with stormwater. Storage or laydown areas will be maintained with good housekeeping, and regularly inspected for spills, leaks, and the potential of materials commingling with stormwater. Any minor spills or leaks will be cleaned up immediately.

Spill Response

Spills will be reported to the SWMP administrator and/or other appropriate Chevron contacts. Chevron will direct the appropriate personnel to handle the spill in accordance with the SPCC plan or other Chevron procedures, and report the spill to any applicable agencies. Spilled material and/or contaminated soil will be disposed of in accordance with all applicable regulations.

Spill reporting requirements are summarized in CDPHE's 2009 Environmental Spill Reporting brochure. Spills of exploration and production wastes are also subject to the more recent reporting requirements reflected in amended COGCC Rule 906, in effect as of February 1, 2014. The referenced brochure, rule, and SPCC Plan narrative are included as **Appendix E**.

3.C.5 Dedicated Asphalt or Concrete Batch Plants

Dedicated asphalt or concrete batch plants are not anticipated within the project site. However, if the need for a batch plant arises, proper management techniques will be utilized. See SM-11 Temporary Batch Plant (TBP) in the BMP Manual for batch plant management techniques. Any asphalt or concrete plants used, along with associated BMPs will be shown on the site map.

3.C.6 Vehicle Tracking

In order to limit vehicle tracking of sediment, vehicles will use designated entry points into construction areas. Access roads and drive paths on pads will be sloped and maintained such that stormwater exits quickly, limiting the potential for excessive mud and rutting. Stabilization methods, such as road base and chemical stabilizers, along with Vehicle Tracking Control (VTC) and Stabilized Construction Roadway (SCR) (See SM-4 and SM-5 in the BMP Manual) will be used where practicable. The location of vehicle tracking controls will be shown on the site specific map.

3.C.7 Waste Management and Disposal, Concrete Washout, and Contaminated Soils

Waste Management and Disposal

Exploration and production wastes will be managed in accordance with the COGCC 900 Series rules. Construction-related and other trash will be collected in covered containers and hauled off-site for disposal in suitable landfills. Portable toilets may be used to contain sanitary waste, with waste materials regularly pumped and transported off-site for disposal at approved facilities. If portable toilets are used, they will be staked or weighted to prevent tipping. Any slash from clearing activities will, if possible, be chipped and used on site for mulch, or utilized as a brush barrier at the site perimeter.

Concrete Washout

Concrete washout is not anticipated within the project site. However, if the need for concrete washout arises, an appropriate containment structure will be utilized. See MM-1 Concrete Washout Area (CWA) in the BMP Manual for BMP descriptions and construction details of concrete washout containments.

The locations of any waste containments or concrete washout area on site are shown on the site specific map.

3.C.8 Ground Water and Stormwater Dewatering

Groundwater Dewatering

No groundwater dewatering is anticipated at this time. If groundwater is encountered, the dewatering of the site will be done in accordance with Part I.D.3.d of the permit. BMPs to be utilized to prevent the groundwater from leaving the site as surface runoff will be shown on the site map for the disturbance.

Stormwater Dewatering

If the need for stormwater dewatering is encountered, BMPs will be utilized to prevent erosion and trap sediment. See SM-9 Dewatering Operations (DW) in the BMP Manual for BMP descriptions for dewatering operations. The BMPs to be utilized will be shown on the site map for the disturbance.

4. FINAL STABILIZATION AND LONG TERM STORMWATER MANAGEMENT

A site is considered finally stabilized when all ground surface disturbing activities at the site have been completed, and all disturbed areas have been either built on, compacted, covered, paved, or otherwise stabilized in such a way as to minimize erosion to the extent practicable, or a uniform vegetative cover has been established that reflects a total percent plant cover of at least seventy percent (70%) of pre-disturbance levels or reference areas.

Typical seed mix and application rates for the RWSU are presented below in **Table 3**.

Table 3 – Approved Seed Mixtures

Elevations up to 7,000ft

Native Mixture/Variety:

Species	Variety	%in mix	Rate (PLS*lb/acre)	
			<i>Drilled</i>	<i>Broadcast</i>
Streambank Wheatgrass		25	2.8	5.6
Galleta Grass (florete)	Viva	25	2.8	5.6
Alkali Sacation	Sandy Dropseed (If sandy)	25	0.4	0.8
Indian Ricegrass	Paloma	25	3.0	6.0

Native and Introduced Mixture/Variety:

Species	Variety	%in mix	Rate (PLS*lb/acre)	
			<i>Drilled</i>	<i>Broadcast</i>
Crested Wheatgrass	Ephriam	25	1.5	3.0
Galleta Grass (florete)	Viva	10	1.1	2.2
Alkali Sacation	Sandy Dropseed (If sandy)	15	0.2	0.4
Indian Ricegrass	Paloma	25	3.0	6.0
Russian Wildrye	Bozoisky	25	2.5	5.0

Elevations 7,000ft to 9,000ft

Native Mixture/Variety:

Species	Variety	%in mix	Rate (PLS*lb/acre)	
			<i>Drilled</i>	<i>Broadcast</i>
Thickspike Wheatgrass	Critana	25	2.5	5.0
Western WheatGrass	Arriba	25	4.0	8.0
Green Needlegrass		25	2.5	5.0
Prairie Junegrass		15	0.2	0.4
Rocky Mtn. Penstemon	Bandera	10	0.6	1.2
Fourwing Saltbrush		add on	1.0	2.0

Native and Introduced Mixture/Variety:

Species	Variety	%in mix	Rate (PLS*lb/acre)	
			<i>Drilled</i>	<i>Broadcast</i>
Pubescent Wheatgrass	Luna	25	3.5	7.0
Western Whatgrass	Arriba	25	4.0	8.0
Russian Wildrye	Bozoisky	25	2.5	5.0
Alfalfa	Ladak	15	1.2	2.4
Small Burnet	Delar	10	3.0	0.0
Fourwing Saltbrush		add on	1.0	2.0

***PLS = Pure Live Seed**

Sites are considered finally stabilized once site preparation and interim reclamation (COGCC Rule 1003) are complete and the above stabilization criteria have been met, even though the site will be disturbed again in the future for final reclamation.

5. INSPECTIONS AND MAINTENANCE PROCEDURES

Site inspections will be conducted with the requirements and minimum schedule as outlined in Part I.D.6 of the CDPS general permit (COR-030000). The requirements are as follows:

- All active construction sites will be inspected at a minimum of at least once every 14 calendar days, and within 24 hours after the end of any precipitation or snowmelt event that causes surface erosion.
- If a site is considered temporarily idle, that is, no construction activities will occur following a storm event, than a post-storm inspection will be conducted prior to re-commencing

constructing activities, but no later than 72 hours following the storm event. Routine inspections must still be conducted at least every 14 calendar days.

- For sites or portions of sites in which all construction activities that will result in ground disturbance are completed, and all activities for final stabilization, as outlined above in section 4, with the exception of vegetative coverage are completed, inspections will be conducted at least once every month, and post-storm inspections are not required.
- Inspections are not required at sites where snow cover exists over the entire site for an extended period of time as long as melting conditions do not exist. The following information must be documented in the inspection record for the use of this exclusion: dates when snow cover occurred, date when construction activities ceased, and date melting conditions began.

A trained and qualified person familiar with the SWMP and stormwater controls will conduct all inspections. The scope of the inspection will cover the construction site perimeter, all disturbed areas, material and/or waste storage areas that are exposed to precipitation, discharge locations, and locations where vehicles access the site. These areas will be inspected for evidence of, or the potential for, pollutants leaving the construction site boundaries entering the stormwater drainage system, or discharging to waters of the state. Also, all erosion and sediment control practices identified in this SWMP will be evaluated to ensure that they are maintained and operating correctly.

Personnel performing site inspections will record the information as outlined below on the inspection report. This inspection report will identify any incidents of non-compliance with the terms and conditions of the general permit. The inspection report will include:

- i. The inspection date
- ii. Name(s) and title(s) of personnel making the inspection
- iii. Location(s) of discharges of sediment or other pollutants from the site
- iv. Location(s) of BMPs that need to be maintained
- v. Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location
- vi. Location(s) where additional BMPs are needed that were not in place at the time of inspection
- vii. Deviations from the minimum inspection schedule as outlined above
- viii. Description of corrective action for items iii, iv, v, and vi, above, dates corrective action(s) taken, and measures taken to prevent future violations, including requisite changes to the SWMP, as necessary
- ix. After adequate corrective action(s) have been taken, or where a report does not identify any incidents requiring corrective action(s), the report shall contain a signed statement indicating the site is in compliance with the permit to the best of the signer's knowledge and belief.

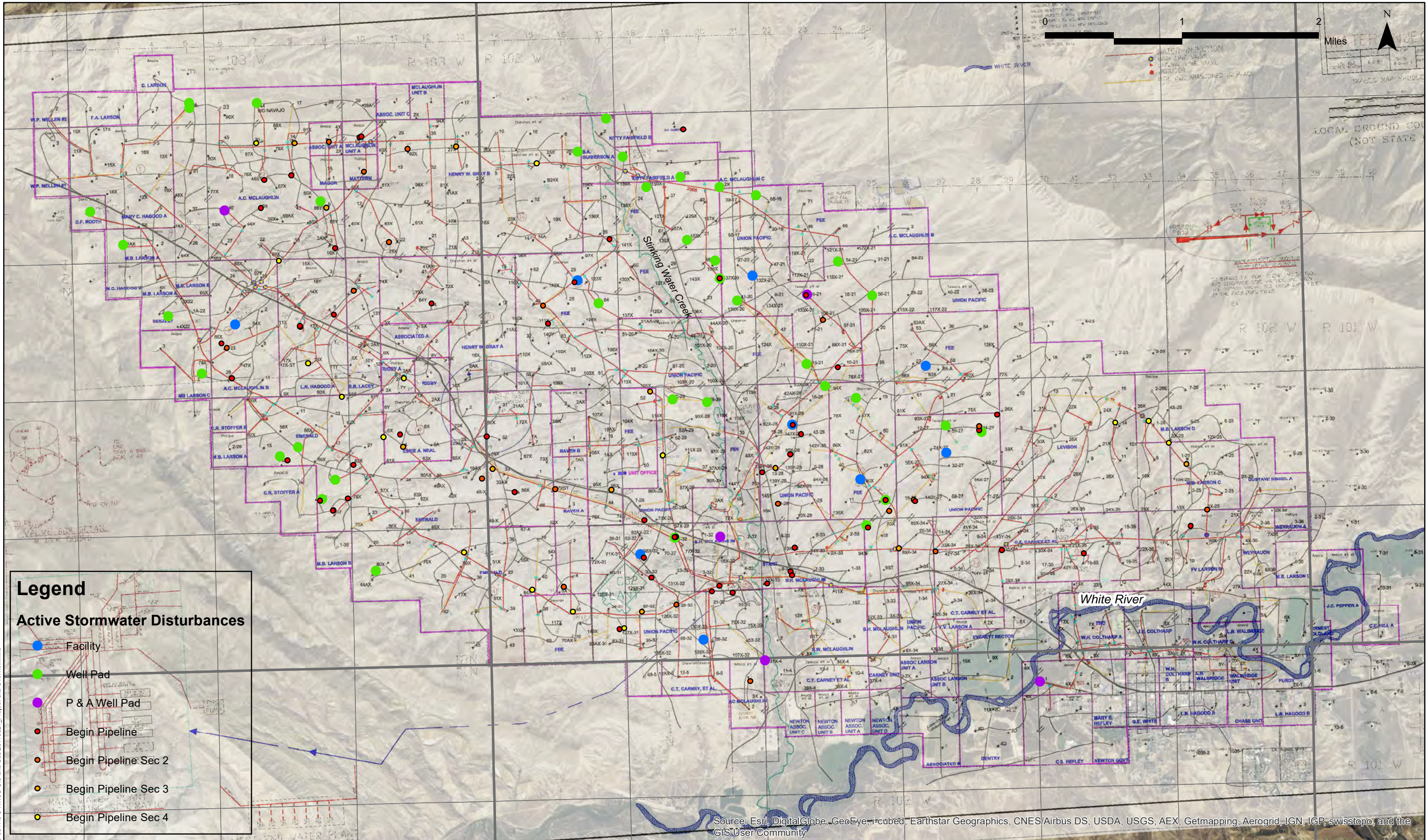
If deficiencies or maintenance issues are noted on the inspection form, or additional BMPs are needed, the Stormwater Administrator will be contacted and they will direct a subcontractor to perform the proper actions.

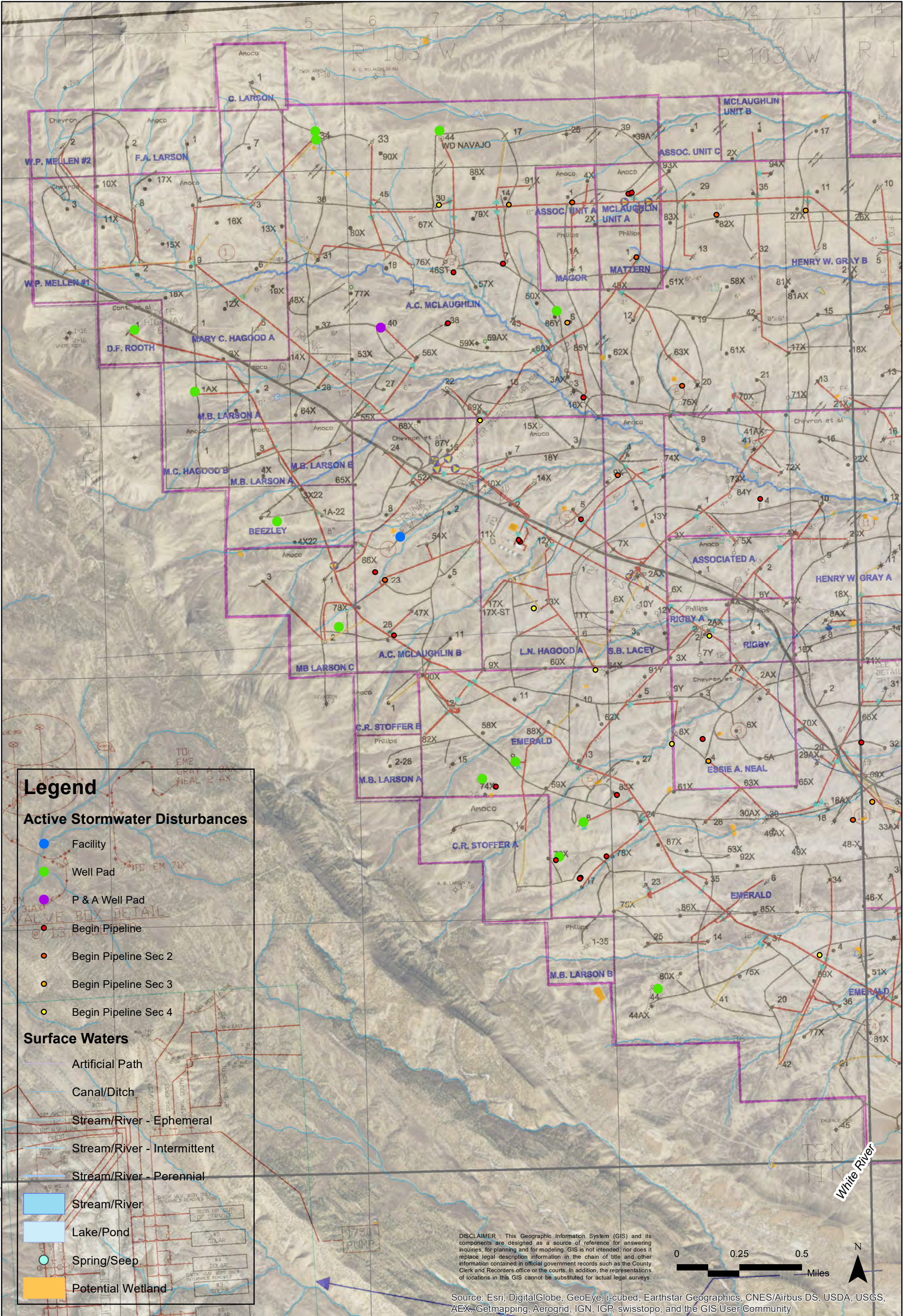
BMPs that have failed, or have the potential to fail without maintenance or modification, will be addressed as soon as possible, immediately in many cases, to prevent the discharge of

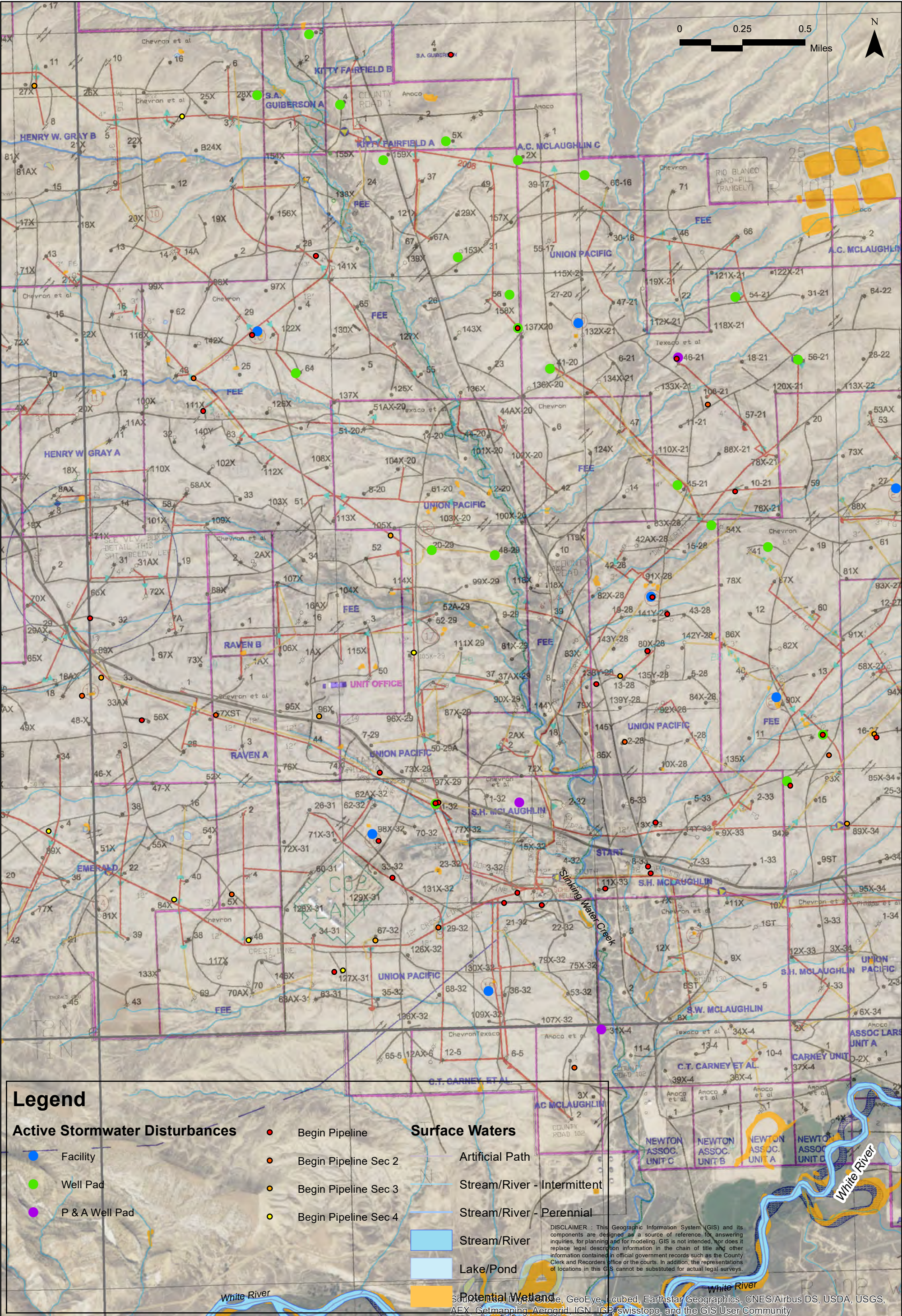
pollutants. All BMPs will be adequately maintained in accordance with good engineering, hydrologic and pollution control practices, including removal of collected sediment outside the acceptable tolerances of the BMPs.

All inspection records will be kept within a StormPro Max online stormwater management database for a minimum of three years from expiration or inactivation of permit coverage.

Figures







Legend

Active Stormwater Disturbances

- Facility
- Well Pad
- P & A Well Pad

- Begin Pipeline
- Begin Pipeline Sec 2
- Begin Pipeline Sec 3
- Begin Pipeline Sec 4

Surface Waters

- Artificial Path
- Stream/River - Intermittent
- Stream/River - Perennial
- Stream/River
- Lake/Pond
- Potential Wetland

DISCLAIMER : This Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling, and are not intended to replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Records Office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

Project Number: 009-0944
Drawn By: SBS
Revision Date: 8/29/2017

Project Site Overview - Central
Chevron U.S.A. Inc.
Rangely Weber Sand Unit
Rio Blanco County, Colorado



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
P: 970.263.7800
F: 970.263.7456

Figure

3

Appendix A

CDPS Certification COR-03F434

General Permit COR-030000

Related Documents

STATE OF COLORADO
Oil and Gas Construction Field Permit Certification
NOTICE OF AMENDMENT OF PERMIT COVERAGE
Terminating coverage for a portion of a permitted area
GENERAL PERMIT FOR
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY

This form is for construction activities associated with oil and gas construction only. The form is applicable to field permit certifications **only**, and is **not** applicable to construction activities for other sectors, such as residential, commercial, or transportation. Additional options for administration and amendments for construction permits, including for activities not associated with oil and gas, is available on the Division's permitting web page, coloradowaterpermits.com (follow the link to "Stormwater Permitting," and then "Construction Stormwater").

This form is to be used to amend an oil and gas field permit certification under Colorado's Stormwater Construction Permit, to terminate permit coverage when **all of the following conditions have been met:**

1. The permit certification to be amended is a field permit certification for construction associated with oil and gas construction. The field permit covers all construction activities disturbing over one acre, or that are part of a common plan of development exceeding one acre, within the applied-for field.
2. The area is a distinct and separate area where construction has been completed and is not part of a specific facility, such as a single well pad or road segment, where construction is ongoing.
3. The area must be **Finally Stabilized**. An area is Finally Stabilized when all ground surface disturbing activities at the site have been completed, and all disturbed areas have been either built on, paved or equivalently hard-armored, or a uniform vegetative cover has been established with an individual plant density of at least 70 percent of pre-disturbance levels.

Upon acceptance of this notice by the Water Quality Control Division (the Division), the permit certification will be automatically amended to exclude the specific portion described in the notice. **The current permittee will not receive a revised certification.** The corrected information will be placed in the permit file. In order to receive notification of the Division's receipt of this information, it is up to the permittee to request verification of delivery from the carrier (i.e., by sending certified mail).

If the Area Has Not Been Finally Stabilized: This form is only for terminating an area that has been finally stabilized. If the area has not been finally stabilized the permittee must either maintain permit coverage, or can reassign permit coverage to another entity that owns or has operational control over that area. The Division's Notice of Reassignment of Permit Coverage form should be used. The form is available at coloradowaterpermits.com

Stormwater Management Plan (SWMP): The permittee must maintain a SWMP that accurately reflects the activities and BMPs for the areas for which they will have permit coverage. Therefore, the SWMP must be updated to reflect the changes described in this form. Appendix A of the General Permit Application and SWMP Guidance for Stormwater Discharges Associated with Construction Activity (available from the Division's web site at coloradowaterpermits.com) contains the requirements for the SWMP.

Failure by the permittee to maintain a SWMP in accordance with this guidance is a violation of the permit. Additional guidance for multi owner/operator development is also available in the Stormwater Fact Sheet for Construction, available from the Division's web site.

Notice Due Dates: At least **ten days** prior to the requested effective date for permit coverage to end, the permittee shall submit this form to the Division. This form may be reproduced, and is also available from the Division's web site at coloradowaterpermits.com

Permit Fee: There are no new permit fees associated with amending the construction permit certification.

Application Completeness: All items on the form must be completed accurately and in their entirety or the notice will be deemed incomplete, and processing of the form will not begin until all information is received. A map of the revised area **must** be included that clearly indicates the area with continued coverage under the permit certification, and the area excluded. (Do **not** include a copy of the SWMP.) One original copy of the completed form (**no faxes or e-mails**), signed by the current permittee, shall be submitted, only to:

Colorado Department of Public Health and Environment
Water Quality Control Division - Permits
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

If you have questions on completing this application, you may contact the Division at cdphe.wqstorm@state.co.us or (303) 692-3517.

SITE MAP INSTRUCTIONS

Site Map: A Site Map **must** be provided. The map must clearly define the boundaries of the area to be excluded from permit coverage relative to that with continued coverage. The level of detail that must be provided will depend on the nature of the project, and must be adequate to determine during a field audit what construction activities are still covered under the issued certification. Two maps (a vicinity map and excluded site boundary map) may be necessary to provide sufficient detail to meet this requirement for large field areas. Maps must not exceed 8 ½ x 17 inches. Do not submit grading plans or other blueprints as the site map.

Colorado Department of Public Health & Environment
Water Quality Control Division
WQCD-P-B2
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

FOR AGENCY USE ONLY

REC _____
EFF _____
YEAR MONTH DAY

**Amendment notice for
Oil and Gas Construction Field Permit Certification
CONSTRUCTION STORMWATER DISCHARGE GENERAL PERMIT CERTIFICATION**

Please print or type. Form must be filled out completely.

Certification Number: **COR-03** F 4 3 4

Permittee (Company) Name: Chevron USA Inc.

Permittee Address: 100 Chevron Road, Rangely, CO 81648

Phone No. 970-675-3846

Field Permit Certification Information (refer to your permit certification):

Field Permit Site/Facility Name: Rangely Weber Sand Unit County(s): Rio Blanco

Contact Person: Nick Moschetti

Contact Person Phone No.: 970-675-3846 Contact Person Email: nmos@chevron.com

Information on Area to be Excluded from Permit Coverage:

Site Map: **Must include Site Map indicating the boundaries of the area to be excluded from permit coverage.**
Refer to the Site Map Instructions on page ii of this form. Maps must be folded to 8½ x 11 inches.

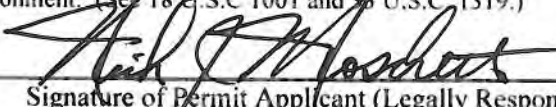
Map enclosed? Yes ☒ No ☐

Summary of work performed and description of final stabilization for the area shown in the attached map:
Thirteen (13) pipelines and ten (10) plugged and abandoned well pads are ready for removal from permit coverage. All disturbances were seeded and are revegetated to at least 70% pre-disturbance levels.

I certify under penalty of law that by the date of my signature below, at the **identified construction site area**, all disturbed soils have been finally stabilized; all temporary erosion and sediment control measures have been removed; all construction and equipment maintenance wastes have been disposed of properly; and all elements of the Stormwater Management Plan have been completed.

I understand that by submitting this notice of amendment, I am no longer authorized to discharge stormwater associated with construction activity by the general permit, **for this specific area**. I understand that discharging pollutants in stormwater associated with construction activities to the waters of the State of Colorado, where such discharges are not authorized by a CDPS permit, is unlawful under the Colorado Water Quality Control Act and the Clean Water Act.

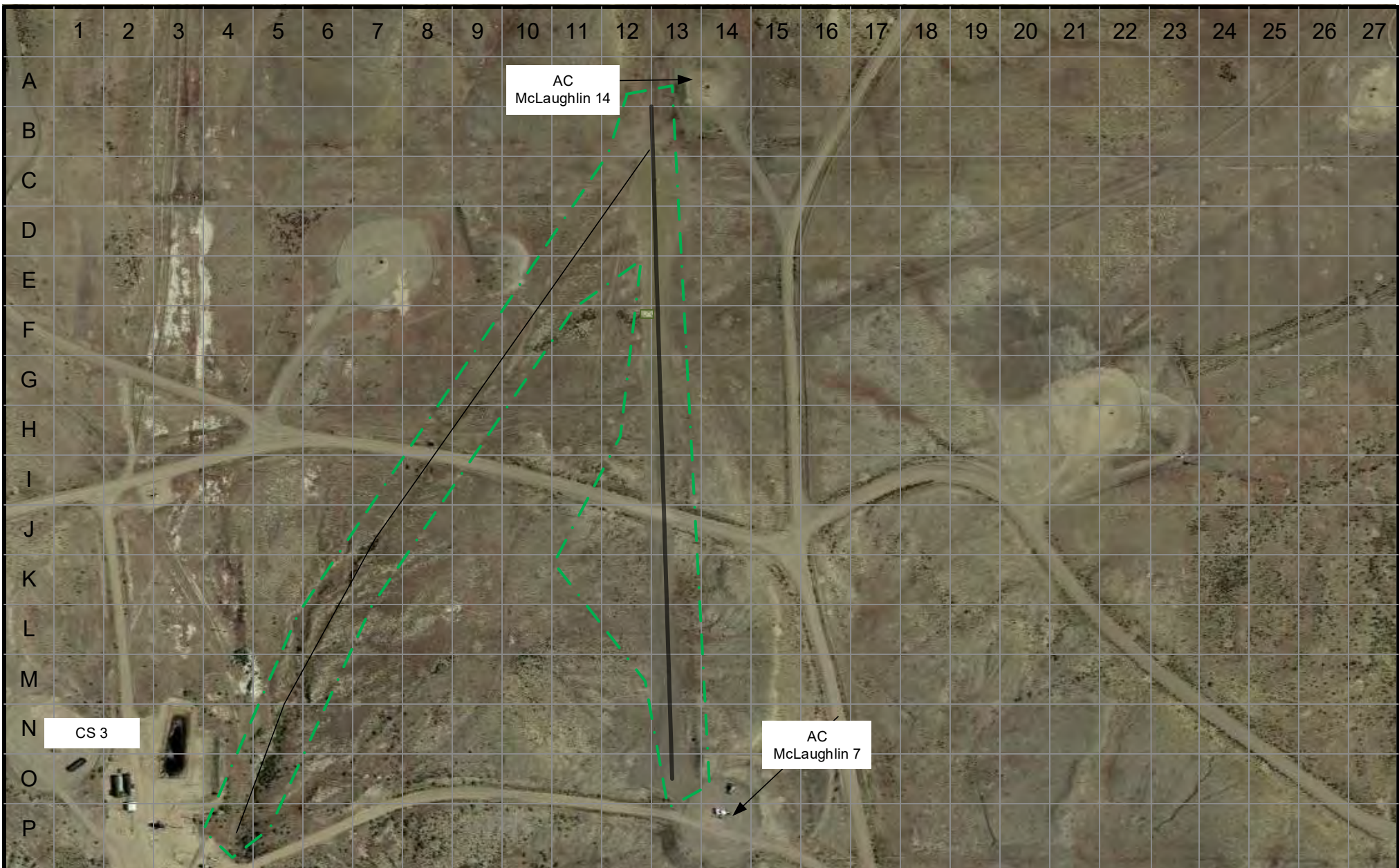
I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (See 18 U.S.C 1001 and 36 U.S.C. 1319.)


Signature of Permit Applicant (Legally Responsible Party)

8/23/2017
Date Signed

Nick Moschetti
Name (printed)

Superintendent
Title



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP
A.C. McL 7 to CS 3
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.14479°N 108.92144°W
END 40.14456°N 108.92456°W



Revised: 8/21/2017 SBS





760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



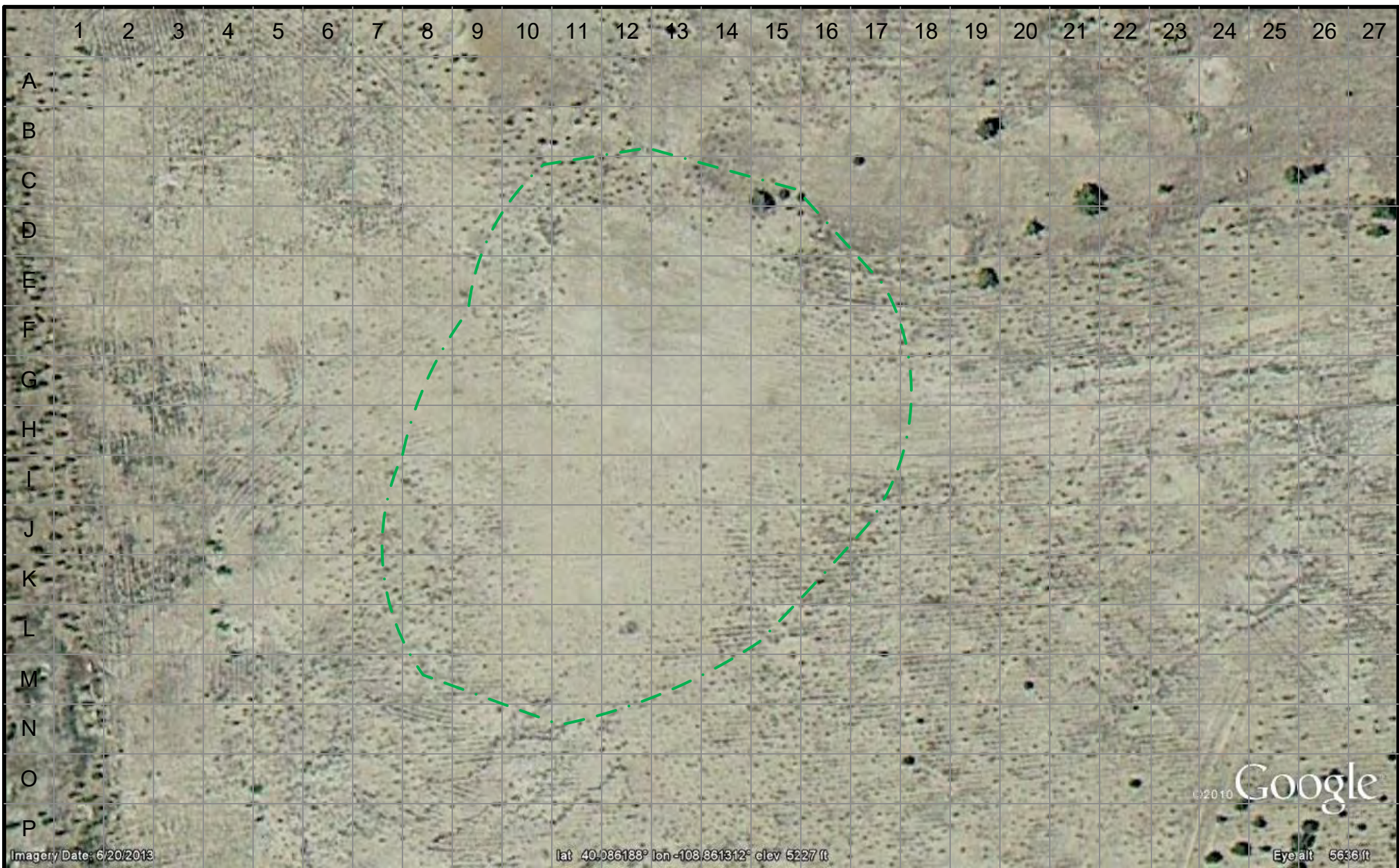
760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
A.C. McL 78X to CS 4
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.12493°N 108.93346°W
END 40.12804°N 108.9306°W



Revised: 8/21/2017 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary



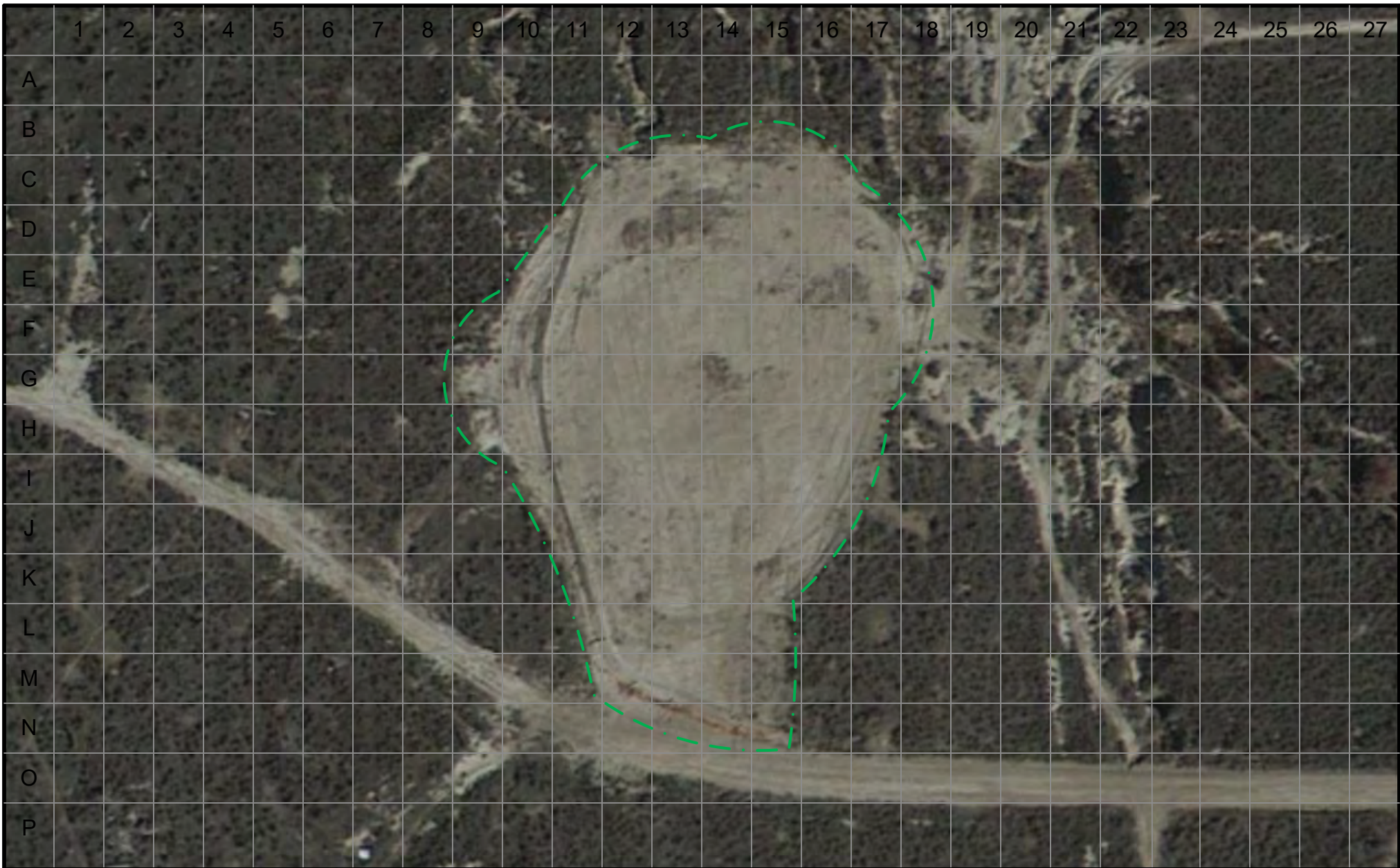
760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
A.C. McLaughlin A2 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.08665°N 108.86005°W



Revised: 5/1/2015 DM



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary

SITE MAP
C.S. Hefley 1 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.08585°N 108.81958°W



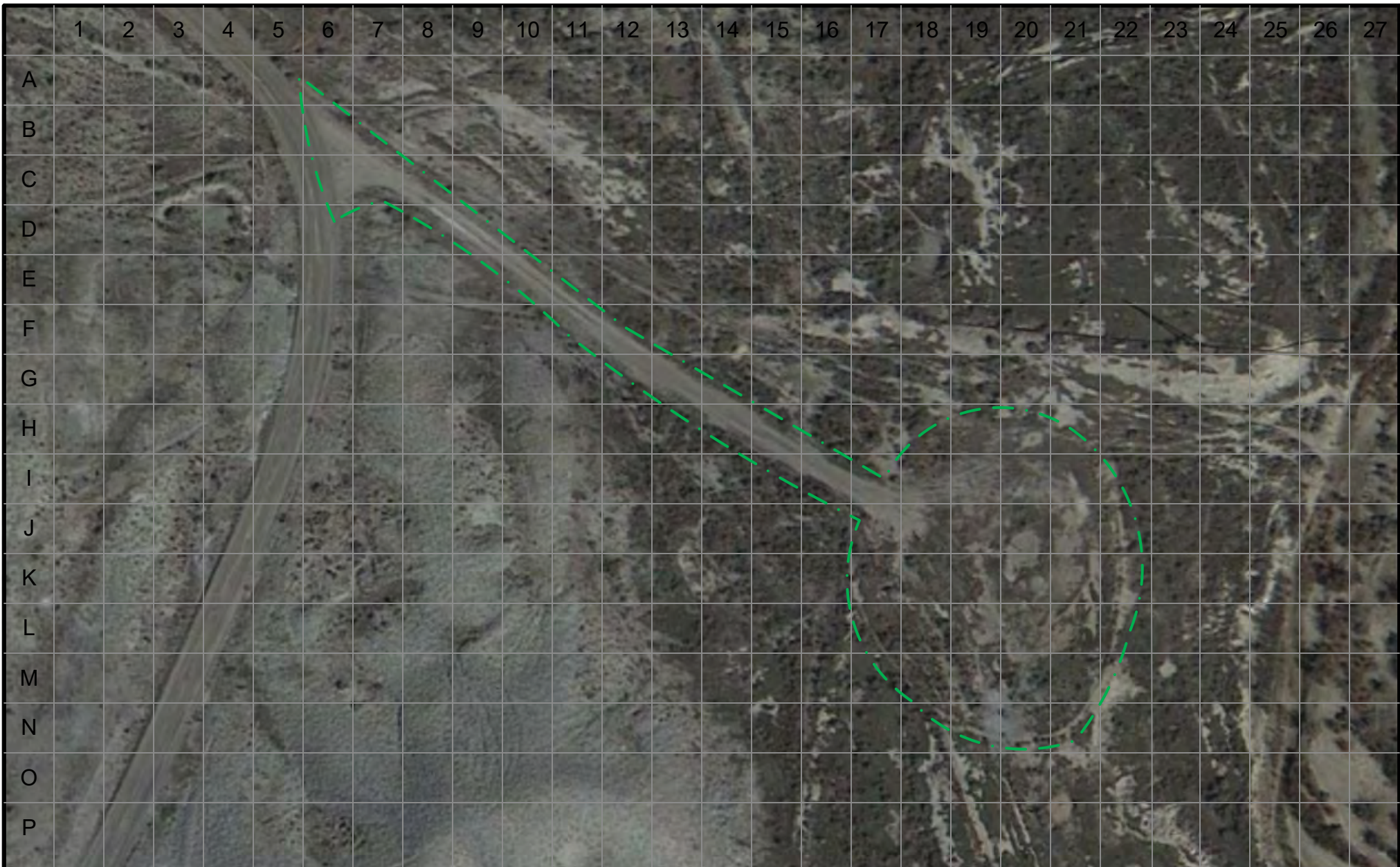
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TEL 970.263.7800
FAX 970.263.7456



Not to
Scale

Image: Google

Revised: 11/22/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary

SITE MAP
C.T. Carney 31-4 and Access P & A
Chevron Corporation
Rio Blanco County, Colorado

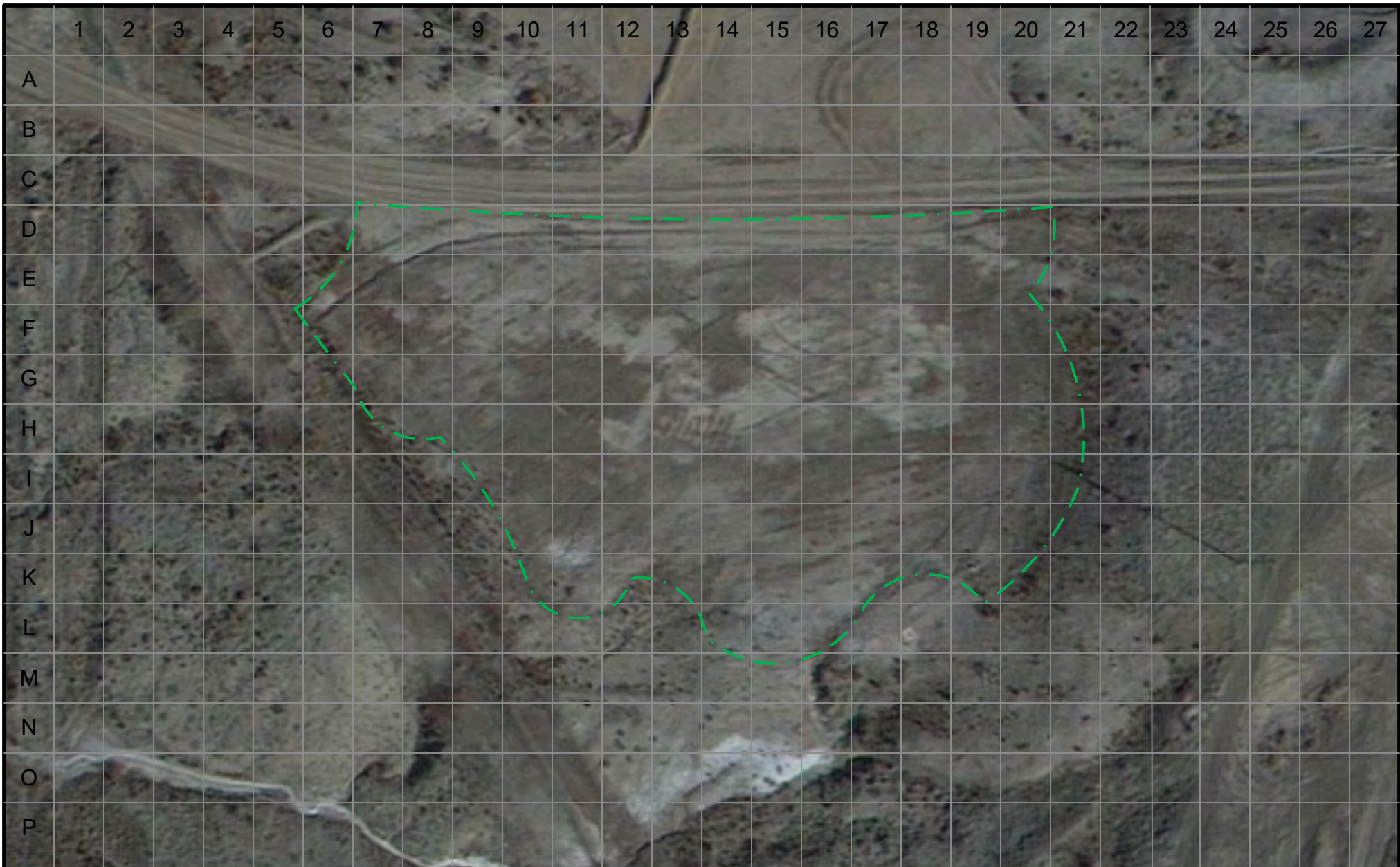
SITE LOCATION:
START 40.09203°N 108.85757°W
END 40.09262°N 108.85904°W



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Revised: 11/18/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary

SITE MAP
C.T. Carney 40Y-35 P & A
Chevron Corporation
Rio Blanco County, Colorado

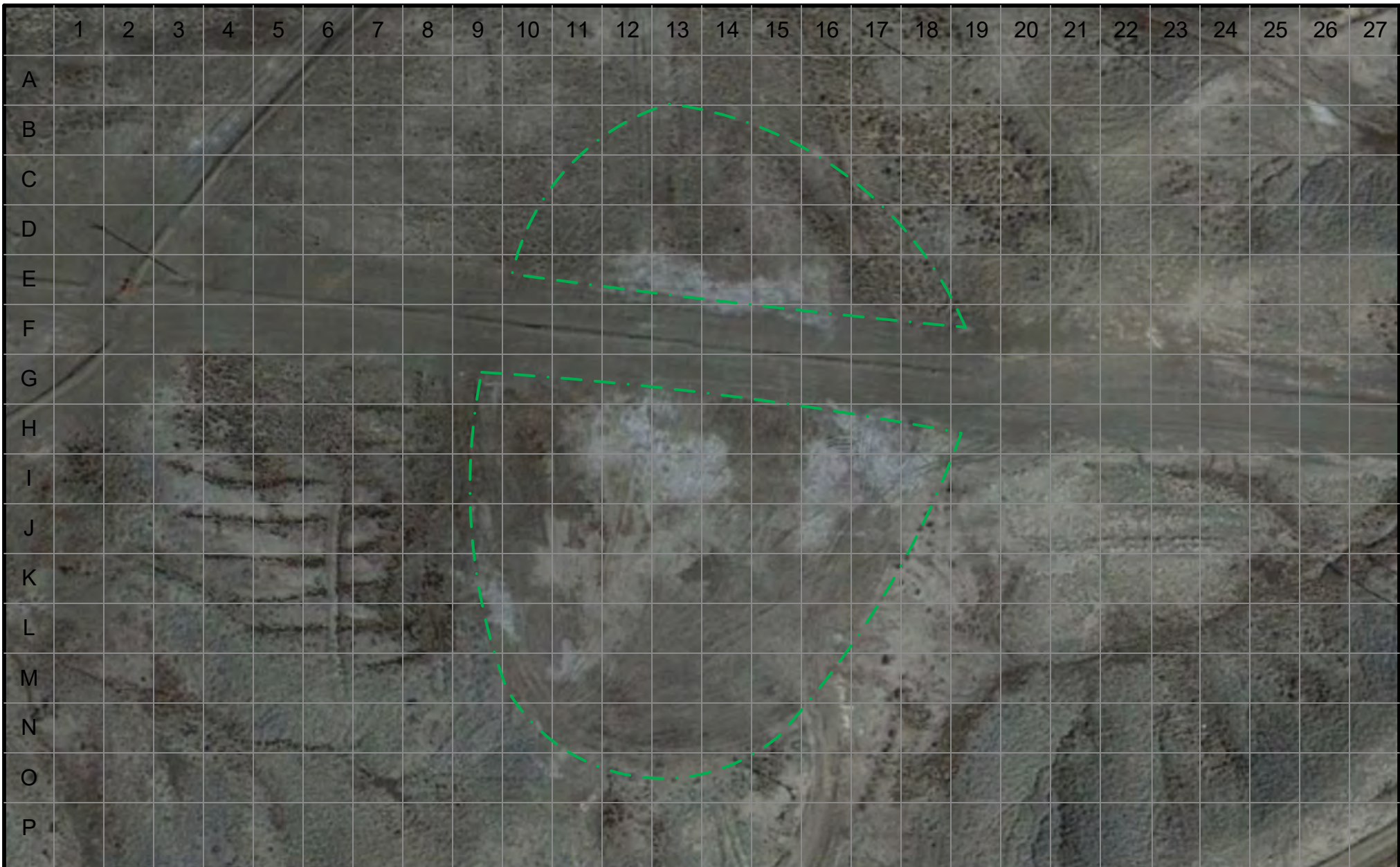
SITE LOCATION:
40.10203°N 108.81443°W



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TEL 970.6753700

LEGEND



Construction Site
Boundary



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TEL 970.263.7800
FAX 970.263.7456

SITE MAP
C.T. Carney 42Y-34 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.10297°N 108.83157°W



Revised: 11/18/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

- Below Surface Pipeline
- Construction Site Boundary

SITE MAP
CS 6 to Emerald 83X
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:



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Grand Junction, CO 81506
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FAX 970.263.7456





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100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



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Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
CS 12 to Fee 97X Pipeline
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.13289°N 108.88211°W
END 40.1352°N 108.88101°W





Revised: 11/18/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
CS 22 (1-3) to U.P. 91X28 (red)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.11689°N 108.85293°W
END 40.11806°N 108.85243°W



Revised: 8/21/2017 SBS
Image: Google





100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary

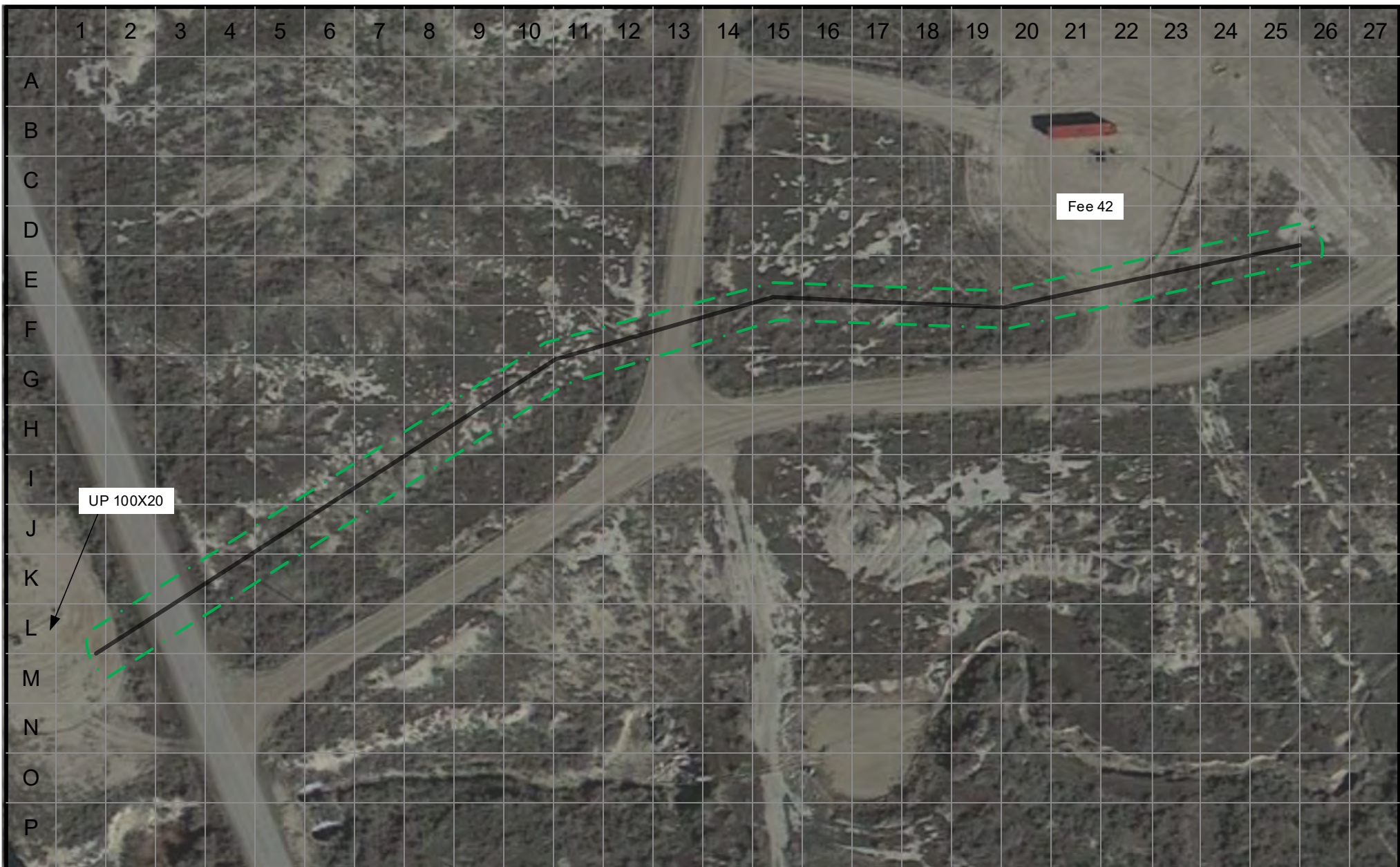
SITE MAP
CS 22 (2-3) U.P. 91X28 to Fee 42 (red)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.118799°N 108.85277°W
END 40.12327°N 108.86005°W





Revised: 8/21/2017 SBS

Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary

SITE MAP
CS 22 (3-3) Fee 42 to U.P. 100X20 (red)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.12272°N 108.86029°W
END 40.12298°N 108.86301°W



Revised: 8/21/2017 SBS



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP
Em 56X (1-4) to Em 26 (green)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.11031°N 108.89075°W
END 40.10908°N 108.88822°W



Revised: 11/15/2013 SBS





760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Em 56X (2-4) Em 26 to U.P. 62AX32 (green)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.10908°N 108.88822°W
END 40.10451°N 108.87495°W



Revised: 11/19/2013 SBS

Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP

Em 56X (3-4) U.P. 62AX32 to U.P. 23-32
(green)

Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:

START 40.10453°N 108.87495°W
END 40.10180°N 108.86918°W



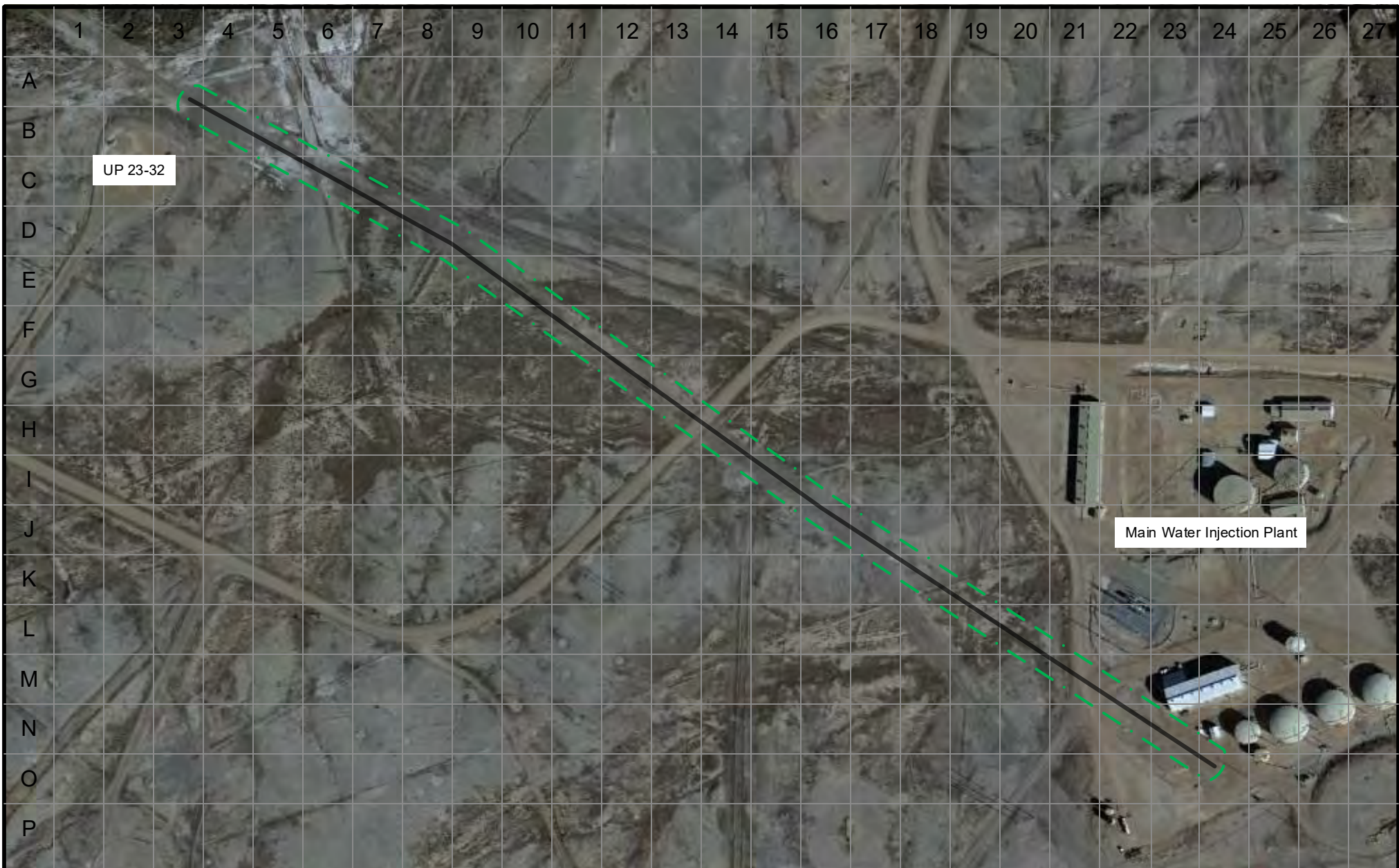
760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



Not to
Scale

Image: Google

Revised: 12/03/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP

Em 56X (4-4) U.P. 23-32 to Main Water
Injection Plant (green)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:

START 40.10180°N 108.86918°W
END 40.09829°N 108.86214°W



Revised: 12/03/2013 SBS

Image: Google



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Emerald 12 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.11923°N108.92658°W



Revised: 8/21/2017 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction
Boundary

SITE MAP
Fee 71 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:

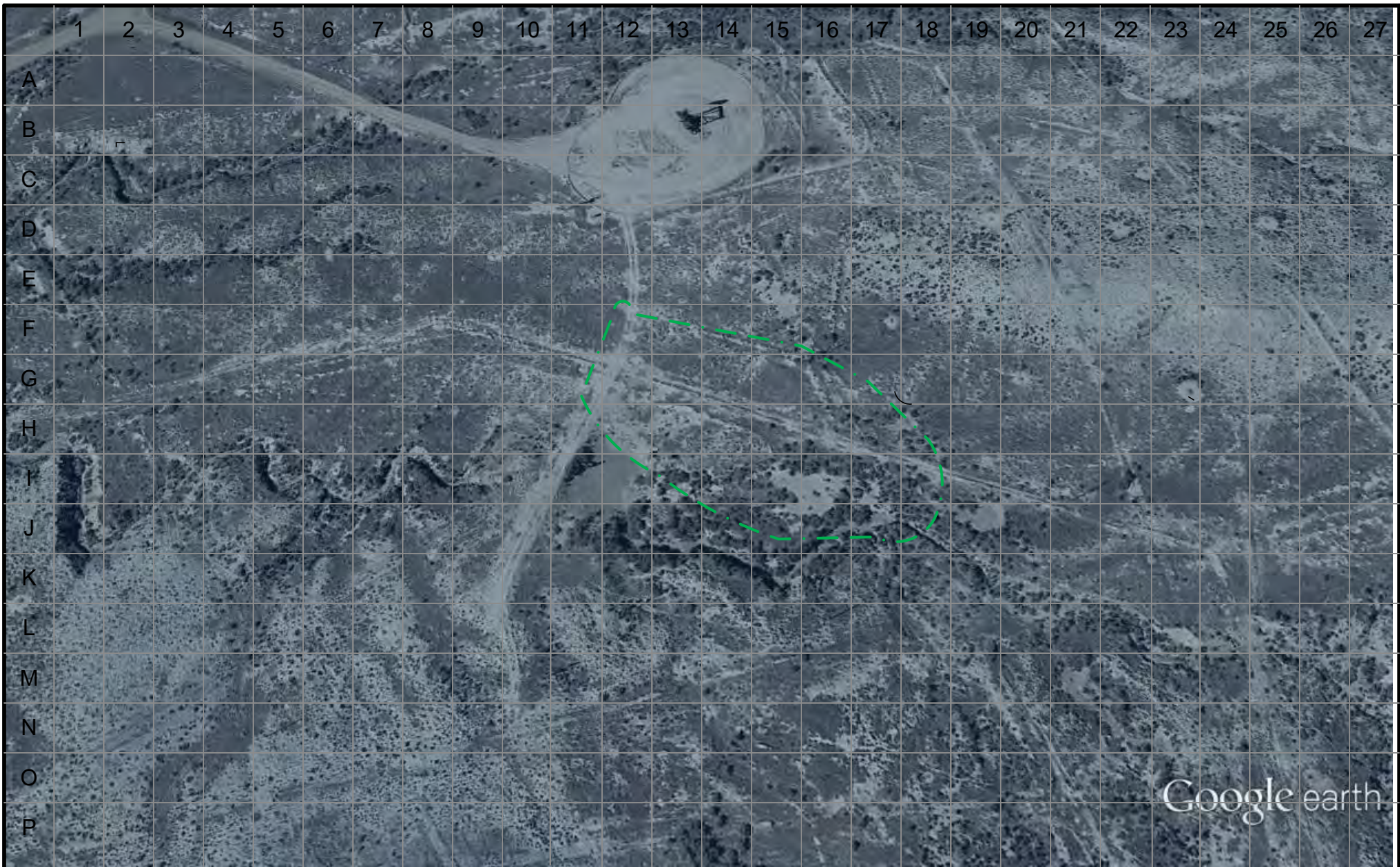


760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



Not to
Scale

Revised: 04/21/2016 JD
Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Fee 73X Disturbance
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.124028N 108.838068°W



Revised: 8/21/2017 SBS
Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary

SITE MAP
Fee 77X and Access P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.12129°N 108.82526°W
END 40.12036°N 108.82634°W



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FAX 970.263.7456





Revised: 11/19/2013 SBS
Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Fee 141X to Fee 55 Pipeline (red)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.13621°N 108.87646°W
END 40.13028°N 108.86998°W



Revised: 11/19/2013 SBS

Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Gray A 11AX P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:

40.12834°N 108.89327°W



Not to
Scale

Revised: 11/17/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP
Lateral U.P. 35-32 to U.P. 127X31 (red)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.09414°N 108.87454°W
END 40.09576°N 108.87687°W



Revised: 8/21/2017 SBS



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

- Below Surface Pipeline
- Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
M.E. Hef 5X to CS 47
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.087836 N -108.813058°W
END 40.15052°N 108.91932°W



Revised: 8/1/16 DW



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP

U.P. 48-29 to U.P. 103X20 (red & yellow)
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:

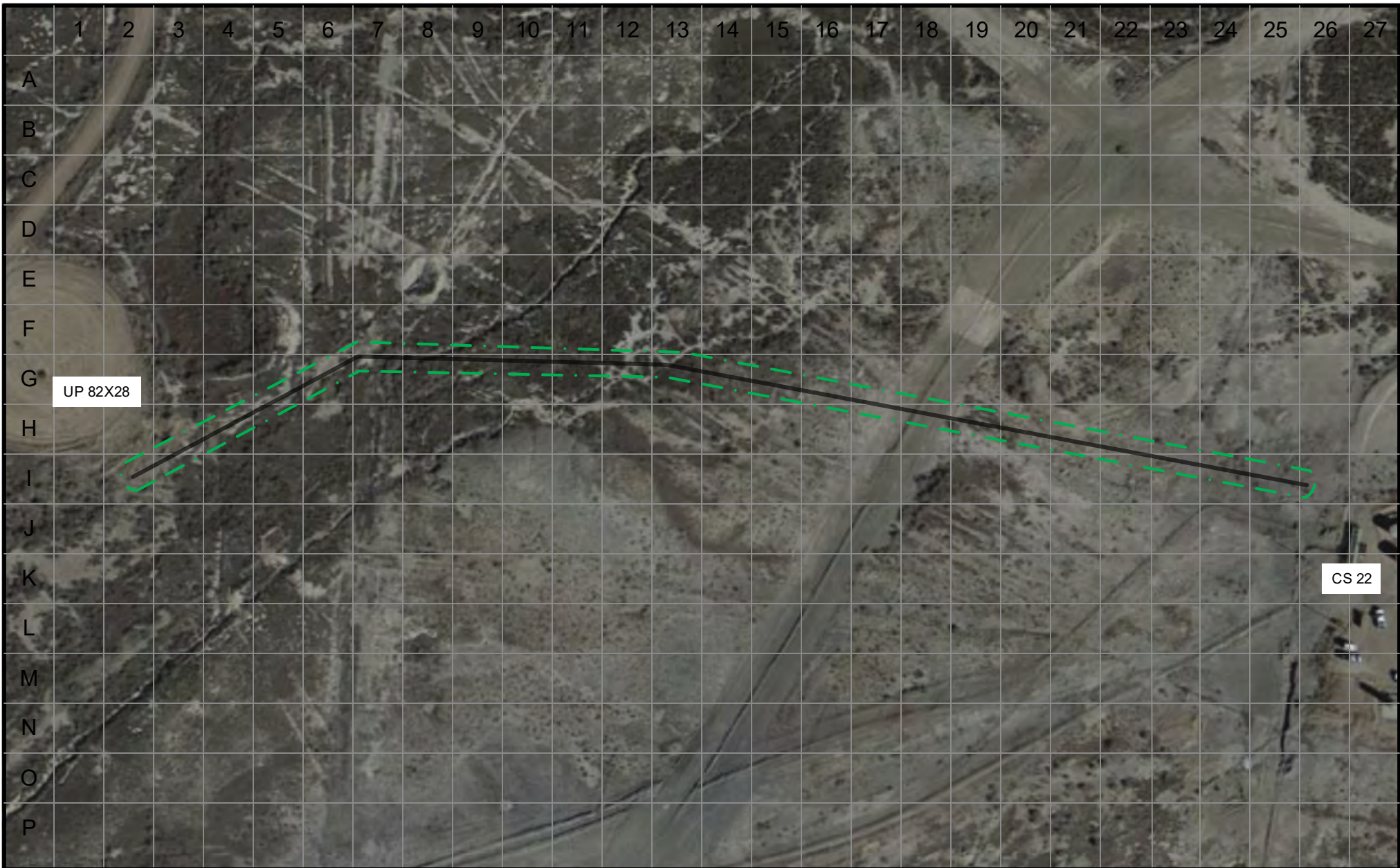
START 40.11956°N 108.86472°W
END 40.12158°N 108.86774°W



Not to
Scale



Revised: 11/21/2013 SBS

Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
U.P. 82X28 to CS 22 (blue)
Chevron Corporation
Rio Blanco County, Colorado

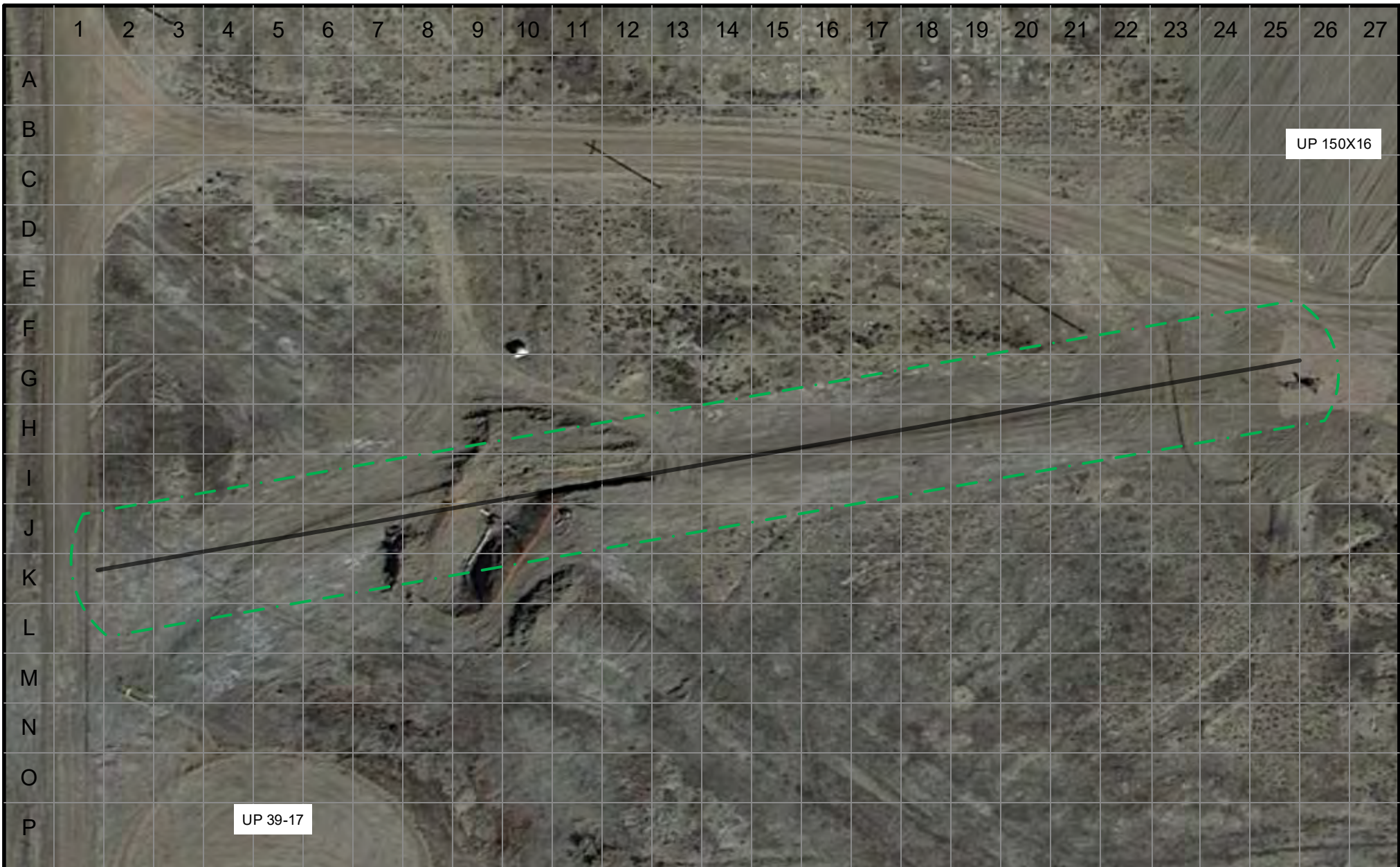
SITE LOCATION:
START 40.11758°N 108.85751°W
END 40.11689°N 108.85293°W



Not to
Scale



Image: Google

Revised: 11/20/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
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FAX 970.263.7456

SITE MAP
U.P. 150X16 (1-2) to U.P. 39-17
Chevron Corporation
Rio Blanco County, Colorado

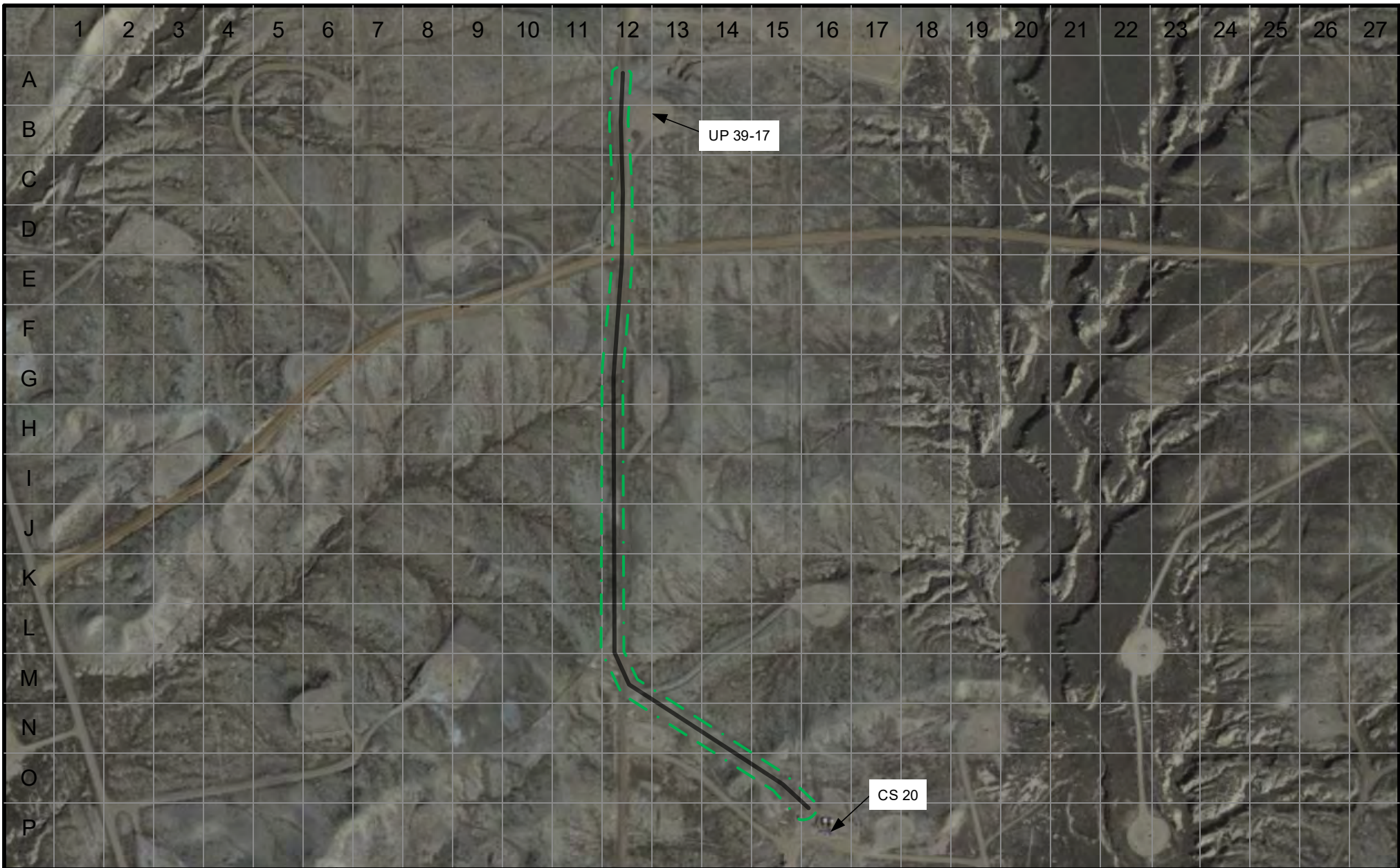
SITE LOCATION:
START 40.14135°N 108.85817°W
END 40.14105°N 108.86040°W



Not to
Scale

Image: Google

Revised: 12/03/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



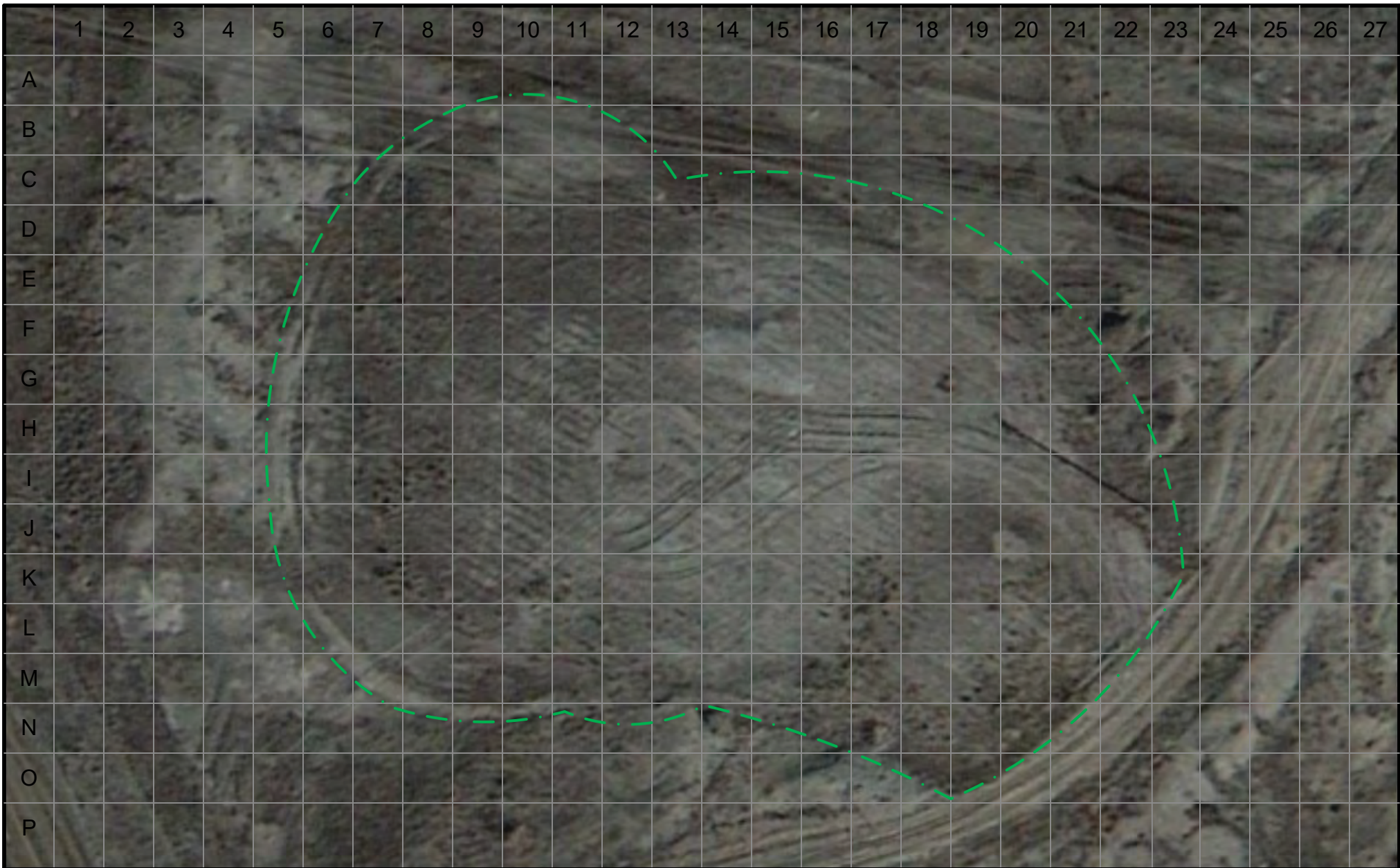
Not to
Scale

Image: Google

SITE MAP
U.P. 150X16 (2-2) U.P. 39-17 to CS 20 satellite
header
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.14103°N 108.86052°W
END 40.13318°N 108.85790°W

Revised: 12/03/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary

SITE MAP
Union Pacific 121X21 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.13659°N 108.84806°W



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



Not to
Scale

Image: Google

Revised: 11/19/2013 SBS

STATE OF COLORADO
Oil and Gas Construction Field Permit Certification
NOTICE OF AMENDMENT OF PERMIT COVERAGE
Terminating coverage for a portion of a permitted area
GENERAL PERMIT FOR
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY

This form is for construction activities associated with oil and gas construction only. The form is applicable to field permit certifications **only**, and is **not** applicable to construction activities for other sectors, such as residential, commercial, or transportation. Additional options for administration and amendments for construction permits, including for activities not associated with oil and gas, is available on the Division's permitting web page, coloradowaterpermits.com (follow the link to "Stormwater Permitting," and then "Construction Stormwater").

This form is to be used to amend an oil and gas field permit certification under Colorado's Stormwater Construction Permit, to terminate permit coverage when **all of the following conditions have been met:**

1. The permit certification to be amended is a field permit certification for construction associated with oil and gas construction. The field permit covers all construction activities disturbing over one acre, or that are part of a common plan of development exceeding one acre, within the applied-for field.
2. The area is a distinct and separate area where construction has been completed and is not part of a specific facility, such as a single well pad or road segment, where construction is ongoing.
3. The area must be **Finally Stabilized**. An area is Finally Stabilized when all ground surface disturbing activities at the site have been completed, and all disturbed areas have been either built on, paved or equivalently hard-armored, or a uniform vegetative cover has been established with an individual plant density of at least 70 percent of pre-disturbance levels.

Upon acceptance of this notice by the Water Quality Control Division (the Division), the permit certification will be automatically amended to exclude the specific portion described in the notice. **The current permittee will not receive a revised certification.** The corrected information will be placed in the permit file. In order to receive notification of the Division's receipt of this information, it is up to the permittee to request verification of delivery from the carrier (i.e., by sending certified mail).

If the Area Has Not Been Finally Stabilized: This form is only for terminating an area that has been finally stabilized. If the area has not been finally stabilized the permittee must either maintain permit coverage, or can reassign permit coverage to another entity that owns or has operational control over that area. The Division's Notice of Reassignment of Permit Coverage form should be used. The form is available at coloradowaterpermits.com

Stormwater Management Plan (SWMP): The permittee must maintain a SWMP that accurately reflects the activities and BMPs for the areas for which they will have permit coverage. Therefore, the SWMP must be updated to reflect the changes described in this form. Appendix A of the General Permit Application and SWMP Guidance for Stormwater Discharges Associated with Construction Activity (available from the Division's web site at coloradowaterpermits.com) contains the requirements for the SWMP.

Failure by the permittee to maintain a SWMP in accordance with this guidance is a violation of the permit. Additional guidance for multi owner/operator development is also available in the Stormwater Fact Sheet for Construction, available from the Division's web site.

Notice Due Dates: At least **ten days** prior to the requested effective date for permit coverage to end, the permittee shall submit this form to the Division. This form may be reproduced, and is also available from the Division's web site at coloradowaterpermits.com

Permit Fee: There are no new permit fees associated with amending the construction permit certification.

Application Completeness: All items on the form must be completed accurately and in their entirety or the notice will be deemed incomplete, and processing of the form will not begin until all information is received. A map of the revised area **must** be included that clearly indicates the area with continued coverage under the permit certification, and the area excluded. (Do **not** include a copy of the SWMP.) One original copy of the completed form (**no faxes or e-mails**), signed by the current permittee, shall be submitted, only to:

Colorado Department of Public Health and Environment
Water Quality Control Division - Permits
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

If you have questions on completing this application, you may contact the Division at cdphe.wqstorm@state.co.us or (303) 692-3517.

SITE MAP INSTRUCTIONS

Site Map: A Site Map **must** be provided. The map must clearly define the boundaries of the area to be excluded from permit coverage relative to that with continued coverage. The level of detail that must be provided will depend on the nature of the project, and must be adequate to determine during a field audit what construction activities are still covered under the issued certification. Two maps (a vicinity map and excluded site boundary map) may be necessary to provide sufficient detail to meet this requirement for large field areas. Maps must not exceed 8 ½ x 17 inches. Do not submit grading plans or other blueprints as the site map.

Colorado Department of Public Health & Environment
Water Quality Control Division
WQCD-P-B2
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

FOR AGENCY USE ONLY

REC _____
EFF _____
YEAR MONTH DAY

**Amendment notice for
Oil and Gas Construction Field Permit Certification
CONSTRUCTION STORMWATER DISCHARGE GENERAL PERMIT CERTIFICATION**

Please print or type. Form must be filled out completely.

Certification Number: **COR-03** F 4 3 4

Permittee (Company) Name: Chevron USA Inc.

Permittee Address: 100 Chevron Road, Rangely, CO 81648

Phone No. 970-675-3846

Field Permit Certification Information (refer to your permit certification):

Field Permit Site/Facility Name: Rangely Weber Sand Unit County(s): Rio Blanco

Contact Person: Nick Moschetti

Contact Person Phone No.: 970-675-3846 Contact Person Email: nmos@chevron.com

Information on Area to be Excluded from Permit Coverage:

Site Map: Must include Site Map indicating the boundaries of the area to be excluded from permit coverage.

Refer to the Site Map Instructions on page ii of this form. Maps must be folded to 8½ x 11 inches.

Map enclosed? Yes ☒ No ☐

Summary of work performed and **description of final stabilization for the area shown in the attached map:**
Twelve (12) pipelines and three (3) plugged and abandoned well pads are ready for removal from permit coverage. All disturbances were seeded and are revegetated to at least 70% pre-disturbance levels.

I certify under penalty of law that by the date of my signature below, at the **identified construction site area**, all disturbed soils have been finally stabilized; all temporary erosion and sediment control measures have been removed; all construction and equipment maintenance wastes have been disposed of properly; and all elements of the Stormwater Management Plan have been completed.

I understand that by submitting this notice of amendment, I am no longer authorized to discharge stormwater associated with construction activity by the general permit, **for this specific area**. I understand that discharging pollutants in stormwater associated with construction activities to the waters of the State of Colorado, where such discharges are not authorized by a CDPS permit, is unlawful under the Colorado Water Quality Control Act and the Clean Water Act.

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (See 18 U.S.C 1001 and 33 U.S.C. 1319.)

Nick Moschetti
Signature of Permit Applicant (Legally Responsible Party)

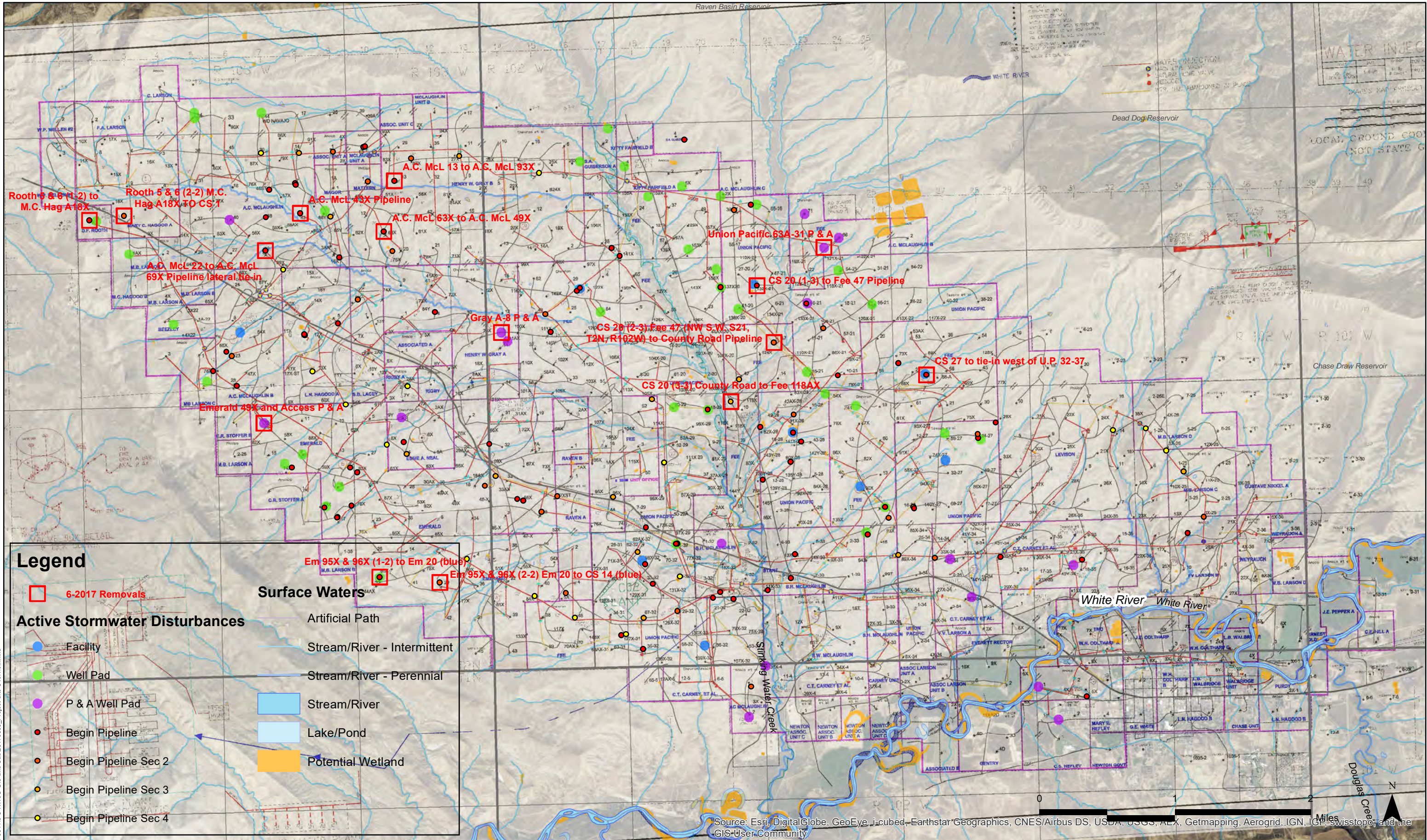
6/12/2017
Date Signed

Nick Moschetti

Name (printed)

Superintendent

Title



Project Number: 009-0944	Project Site Overview - June 2017 Removals Chevron U.S.A. Inc. Rangely Weber Sand Unit Rio Blanco County, Colorado		760 Horizon Drive, Suite 102 Grand Junction, CO 81506 P: 970.263.7800 F: 970.263.7456	DISCLAIMER : This Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended, nor does it replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Records office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.	Figure
Drawn By: SBS					1
Revision Date: 6/9/2017					

\\den-fs1\projects\Projects\009-0944\6-C-RWSU-GIS and Geo\20170606-Project Site Overview.mxd



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP
A.C. McL 22 to A.C. McL 69X Pipeline lateral tie-in
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.13768°N 108.92581°W
END 40.13621°N 108.92419°W



Revised: 11/18/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline
Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
A.C. McL 43X Pipeline
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.14138°N 108.92062°W
END 40.13992°N 108.91786°W



Image: Google

Revised: 12/02/2013 SBS





100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary

SITE MAP
A.C. McL 63X to A.C. McL 49X
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.13926°N 108.90928°W
END 40.14316°N 108.91301°W



Revised: 06/08/2017 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP

CS 20 (1-3) to Fee 47 Pipeline
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:

START 40.13266°N 108.85749°W
END 40.12657°N 108.85532°W



Not to
Scale



Revised: 11/20/2013 SBS

Image: Google



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

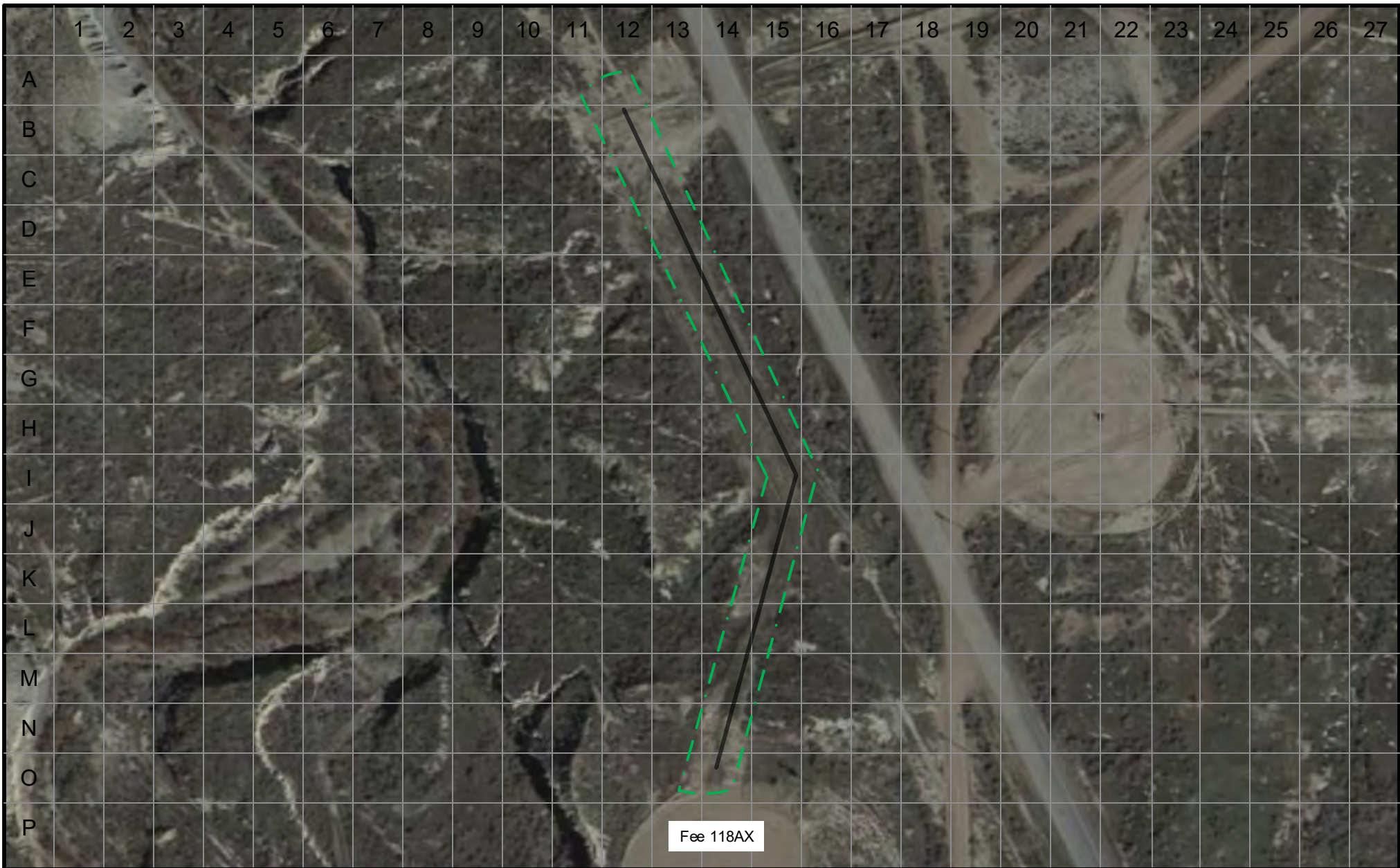
SITE MAP
CS 20 (2-3) Fee 47 (NW S.W. S21, T2N,
R102W) to County Road Pipeline
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.12657°N 108.85532°W
END 40.12035°N 108.86151°W





Image: Google

Revised: 11/20/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND

-  Below Surface Pipeline
-  Construction Site Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
CS 20 (3-3) County Road to Fee 118AX
Chevron Corporation
Rio Blanco County, Colorado

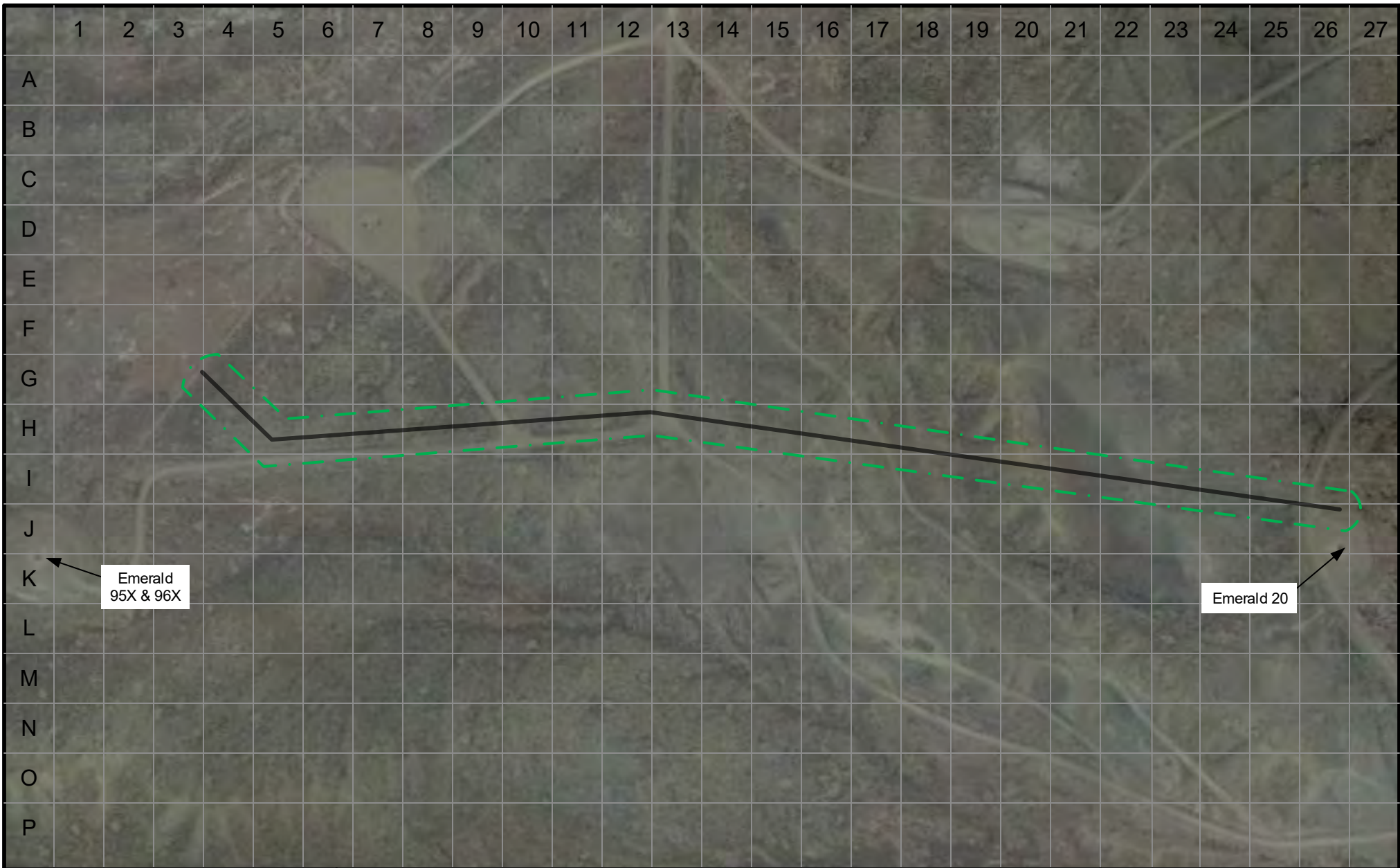
SITE LOCATION:
START 40.12035°N 108.86151°W
END 40.11829°N 108.86164°W



Not to
Scale

Image: Google

Revised: 11/20/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.675.3700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP
Em 95X & 96X (1-2) to Em 20 (blue)
Chevron Corporation
Rio Blanco County, Colorado

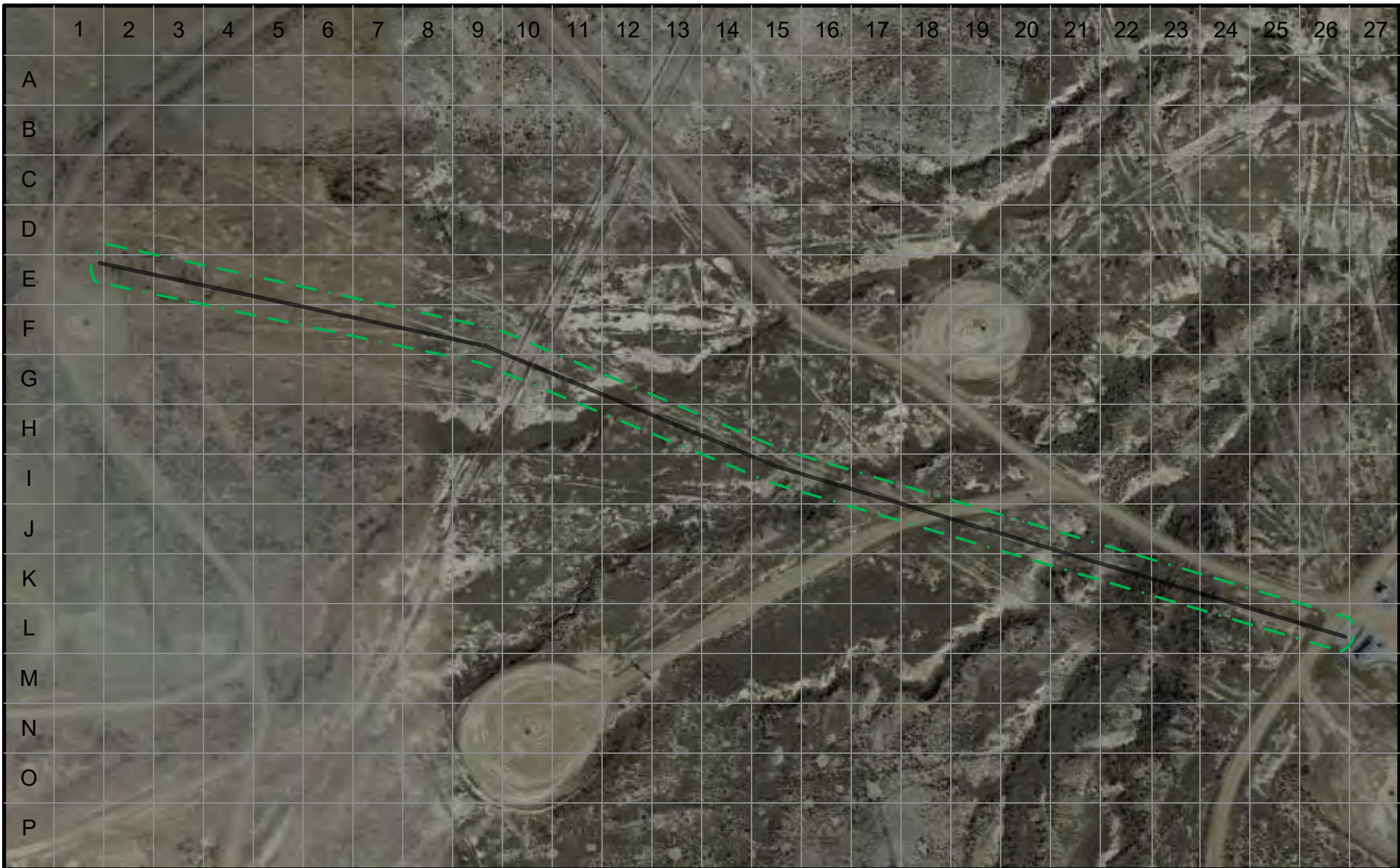
SITE LOCATION:
START 40.10249°N 108.91099°W
END 40.10177°N 108.90264°W



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



Revised: 11/07/2013 SBS



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Below Surface
Pipeline



Construction Site
Boundary

SITE MAP
Em 95X & 96X (2-2) Em 20 to CS 14 (blue)
Chevron Corporation
Rio Blanco County, Colorado

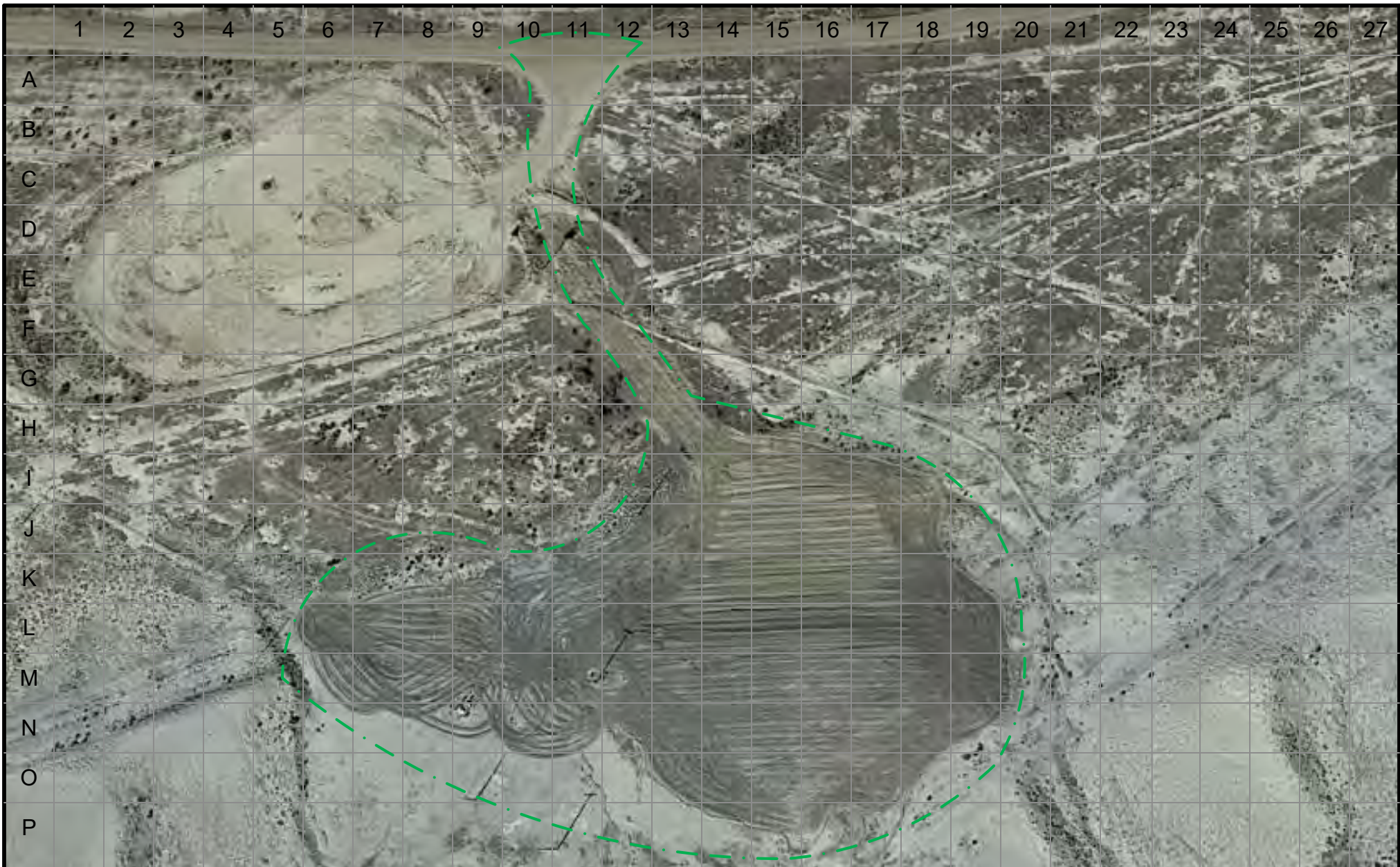
SITE LOCATION:
START 40.10177°N 108.90264°W
END 40.10011°N 108.89537°W



Revised: 11/07/2013 SBS



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Emerald 49X and Access P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
START 40.14714°N 108.90521°W
END 40.14727°N 108.8985°W



Not to
Scale

Image: Google

Revised: 04/21/2016



Imagery Date: 6/20/2013

lat 40.123603° lon -108.897452° elev 5355'ft

Eye alt 5973'ft



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction Site
Boundary



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456

SITE MAP
Gray A-8 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.123603N 108.897452°W



Revised: 5/5/15 DM



100 Chevron Road
Rangely, CO 81648-9705
TEL 970.6753700

LEGEND



Construction
Site Boundary

SITE MAP
Union Pacific 63A-31 P & A
Chevron Corporation
Rio Blanco County, Colorado

SITE LOCATION:
40.09398°N 108.87950°W



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
TEL 970.263.7800
FAX 970.263.7456



Not to
Scale

Image: Google

Revised: 3/5/15 DM



COLORADO

Department of Public
Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

Chevron USA Inc
Nick Moschetti, Supt
100 Chevron Rd
Rangely, CO 81648
nmos@chevron.com

TO: Chevron USA Inc

FROM: Karen Harford, Administrative Assistant, 303-691-4019, Karen.Harford@state.co.us
Debbie Jessop, Technician, 303-692-3590 Debbie.Jessop@state.co.us
Janet Kieler, Permits Section Manager 303-692-3599, Janet.Kieler@state.co.us

DATE: July 29, 2016

RE: Modification Application of Permit to Discharge
Rangely Weber Sand Unit Field Permit
Permit No: COR03F434

The Water Quality Control Division (Division) received your application for a modification to your permit COR03F434 on 7/19/2016. The application is in regards to a discharge authorized from Rangely Weber Sand Unit Field Permit located at SH 64 and SH 139 NW of Rangely, Rangely. The Division reviewed the application and considers it complete for the purposes of filing - The division has not verified all of the information contained in your application and have relied upon your signed certification to determine that the information is true, accurate, and complete.

No changes to your certification are necessary at this time. The modification will be filed with the Certification and associated materials.

cc: mhaub@chevron.com
File Copy



Colorado Department of Public Health & Environment
Water Quality Control Division
WQCD-P-B2
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

FOR AGENCY USE ONLY

REC _____
EFF _____
YEAR MONTH DAY

**Amendment notice for
Oil and Gas Construction Field Permit Certification
CONSTRUCTION STORMWATER DISCHARGE GENERAL PERMIT CERTIFICATION**

Please print or type. Form must be filled out completely.

Certification Number: **COR-03** F 4 3 4

Permittee (Company) Name: Chevron USA Inc.

Permittee Address: 100 Chevron Road, Rangely, CO 81648

Phone No. 970-675-3846

Field Permit Certification Information (refer to your permit certification):

Field Permit Site/Facility Name: Rangely Weber Sand Unit County(s): Rio Blanco

Contact Person: Nick Moschetti

Contact Person Phone No.: 970-675-3846 Contact Person Email: nmos@chevron.com

Information on Area to be Excluded from Permit Coverage:

Site Map: Must include Site Map indicating the boundaries of the area to be excluded from permit coverage.

Refer to the Site Map Instructions on page ii of this form. Maps must be folded to 8½ x 11 inches.

Map enclosed? Yes ☒ No ☐

Summary of work performed and description of final stabilization for the area shown in the attached map:

There are 74 locations ready for removal on this permit. They have been seeded and have reached 70% pre-disturbance levels

There are 9 Plugged and Abandoned Wells that have been reclaimed/seeded and the remaining are pipelines that have been reseeded. All BMP's have been removed.

I certify under penalty of law that by the date of my signature below, at the **identified construction site area**, all disturbed soils have been finally stabilized; all temporary erosion and sediment control measures have been removed; all construction and equipment maintenance wastes have been disposed of properly; and all elements of the Stormwater Management Plan have been completed.

I understand that by submitting this notice of amendment, I am no longer authorized to discharge stormwater associated with construction activity by the general permit, **for this specific area**. I understand that discharging pollutants in stormwater associated with construction activities to the waters of the State of Colorado, where such discharges are not authorized by a CDPS permit, is unlawful under the Colorado Water Quality Control Act and the Clean Water Act.

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (See 18 U.S.C 1001 and 33 U.S.C. 1319.)

Nick Moschetti
Signature of Permit Applicant (Legally Responsible Party)

6/7/2016
Date Signed

Nick Moschetti

Superintendent

Name (printed)

Title

STATE OF COLORADO
Oil and Gas Construction Field Permit Certification
NOTICE OF AMENDMENT OF PERMIT COVERAGE
Terminating coverage for a portion of a permitted area

**GENERAL PERMIT FOR
STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY**

Received
JUL 19 2016
Water Quality Control

This form is for construction activities associated with oil and gas construction only. The form is applicable to field permit certifications **only**, and is **not** applicable to construction activities for other sectors, such as residential, commercial, or transportation. Additional options for administration and amendments for construction permits, including for activities not associated with oil and gas, is available on the Division's permitting web page, coloradowaterpermits.com (follow the link to "Stormwater Permitting," and then "Construction Stormwater").

This form is to be used to amend an oil and gas field permit certification under Colorado's Stormwater Construction Permit, to terminate permit coverage when **all of the following conditions have been met:**

1. The permit certification to be amended is a field permit certification for construction associated with oil and gas construction. The field permit covers all construction activities disturbing over one acre, or that are part of a common plan of development exceeding one acre, within the applied-for field.
2. The area is a distinct and separate area where construction has been completed and is not part of a specific facility, such as a single well pad or road segment, where construction is ongoing.
3. The area must be **Finally Stabilized**. An area is Finally Stabilized when all ground surface disturbing activities at the site have been completed, and all disturbed areas have been either built on, paved or equivalently hard-armored, or a uniform vegetative cover has been established with an individual plant density of at least 70 percent of pre-disturbance levels.

Upon acceptance of this notice by the Water Quality Control Division (the Division), the permit certification will be automatically amended to exclude the specific portion described in the notice. **The current permittee will not receive a revised certification.** The corrected information will be placed in the permit file. In order to receive notification of the Division's receipt of this information, it is up to the permittee to request verification of delivery from the carrier (i.e., by sending certified mail).

If the Area Has Not Been Finally Stabilized: This form is only for terminating an area that has been finally stabilized. If the area has not been finally stabilized the permittee must either maintain permit coverage, or can reassign permit coverage to another entity that owns or has operational control over that area. The Division's Notice of Reassignment of Permit Coverage form should be used. The form is available at coloradowaterpermits.com

Stormwater Management Plan (SWMP): The permittee must maintain a SWMP that accurately reflects the activities and BMPs for the areas for which they will have permit coverage. Therefore, the SWMP must be updated to reflect the changes described in this form. Appendix A of the General Permit Application and SWMP Guidance for Stormwater Discharges Associated with Construction Activity (available from the Division's web site at coloradowaterpermits.com) contains the requirements for the SWMP.

Failure by the permittee to maintain a SWMP in accordance with this guidance is a violation of the permit. Additional guidance for multi owner/operator development is also available in the Stormwater Fact Sheet for Construction, available from the Division's web site.

Notice Due Dates: At least **ten days** prior to the requested effective date for permit coverage to end, the permittee shall submit this form to the Division. This form may be reproduced, and is also available from the Division's web site at coloradowaterpermits.com

Permit Fee: There are no new permit fees associated with amending the construction permit certification.

Application Completeness: All items on the form must be completed accurately and in their entirety or the notice will be deemed incomplete, and processing of the form will not begin until all information is received. A map of the revised area **must** be included that clearly indicates the area with continued coverage under the permit certification, and the area excluded. (Do **not** include a copy of the SWMP.) One original copy of the completed form (**no faxes or e-mails**), signed by the current permittee, shall be submitted, only to:

Colorado Department of Public Health and Environment
Water Quality Control Division - Permits
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

If you have questions on completing this application, you may contact the Division at cdphe.wqstorm@state.co.us or (303) 692-3517.

SITE MAP INSTRUCTIONS

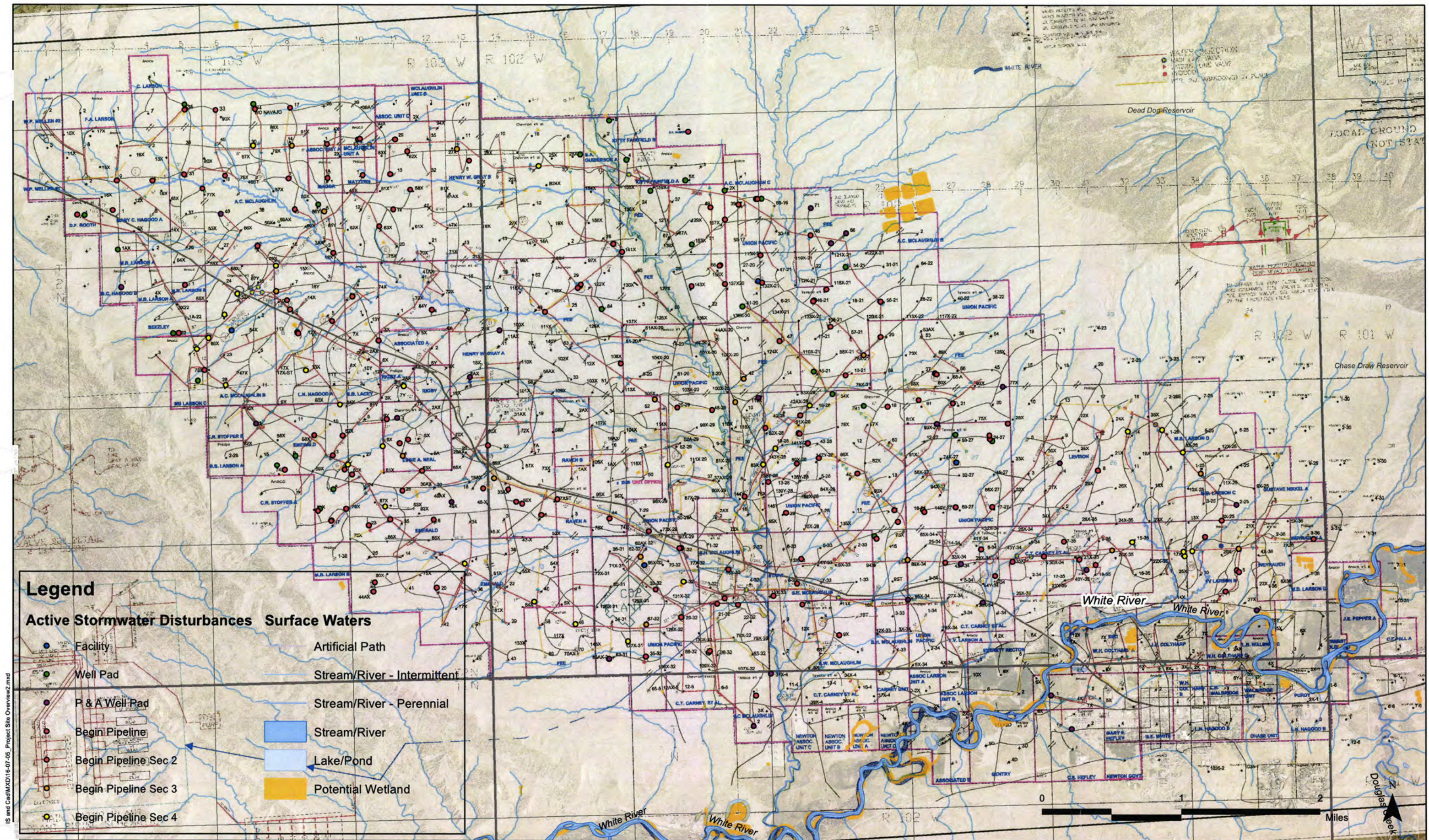
Site Map: A Site Map **must** be provided. The map must clearly define the boundaries of the area to be excluded from permit coverage relative to that with continued coverage. The level of detail that must be provided will depend on the nature of the project, and must be adequate to determine during a field audit what construction activities are still covered under the issued certification. Two maps (a vicinity map and excluded site boundary map) may be necessary to provide sufficient detail to meet this requirement for large field areas. Maps must not exceed 8 ½ x 17 inches. Do not submit grading plans or other blueprints as the site map.

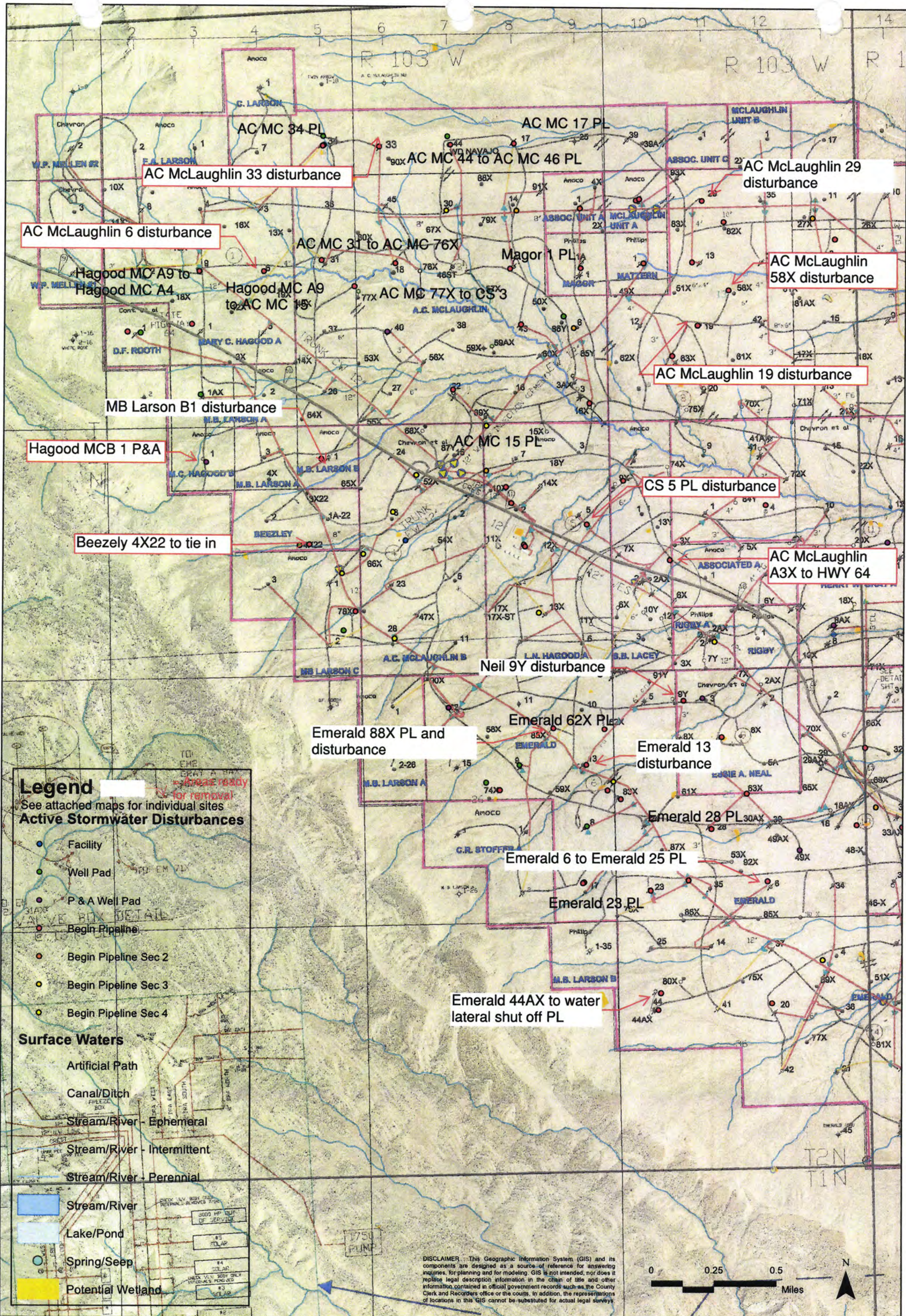
**Amendment Notice for Oil and Gas
Construction**

Field Permit COR-03F434

Chevron USA

Site Maps of Areas Ready for Removal





Legend
See attached maps for individual sites
Active Stormwater Disturbances

- Facility
- Well Pad
- P & A Well Pad
- Begin Pipeline
- Begin Pipeline Sec 2
- Begin Pipeline Sec 3
- Begin Pipeline Sec 4

- Surface Waters**
- Artificial Path
 - Canal/Ditch
 - Stream/River - Ephemeral
 - Stream/River - Intermittent
 - Stream/River - Perennial
 - Stream/River
 - Lake/Pond
 - Spring/Seep
 - Potential Wetland

DISCLAIMER: This Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended, nor does it replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Records office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.



Scanned 14:04:47 on 07/19/2016
F:\Projects\009-00448-C-RWSU-GIS and Cad\T2N16-07-06-Project Site Overview - West - Copy.mxd



Legend

See attached maps for individual sites
Active Stormwater Disturbances

- Facility
- Well Pad
- P & A Well Pad

- Begin Pipeline
- Begin Pipeline Sec 2
- Begin Pipeline Sec 3
- Begin Pipeline Sec 4

Surface Waters

- Artificial Path
- Stream/River - Intermittent
- Stream/River - Perennial
- Stream/River
- Lake/Pond
- Potential Wetland

DISCLAIMER: This Geographic Information System (GIS) and its data were designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended, nor does it replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Records Office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

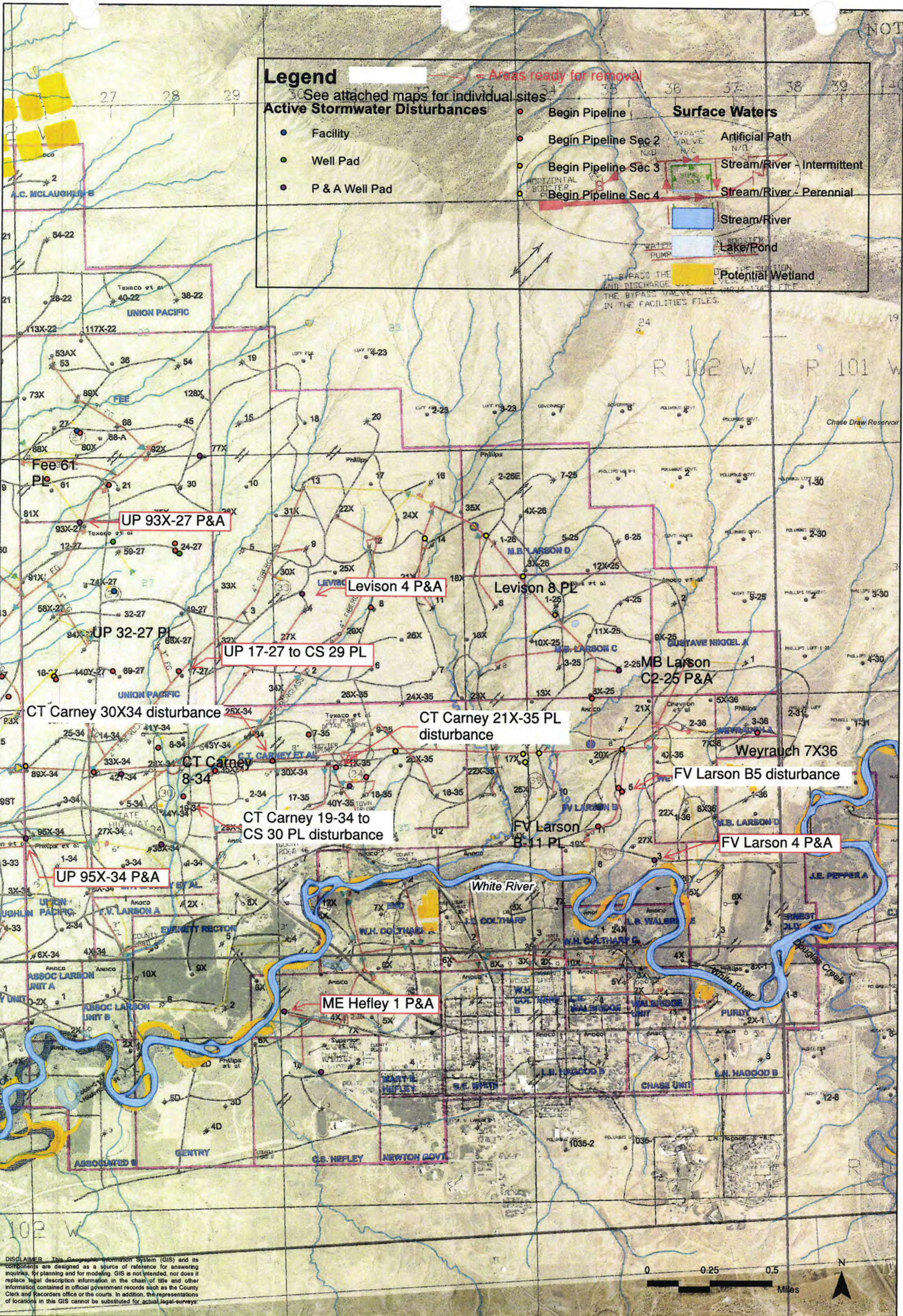
Permit # -COR3F434
Drawn By: DW
Revision Date: 5/26/15

Project Site Overview - Central
Chevron U.S.A. Inc.
Rangely Weber Sand Unit
Rio Blanco County, Colorado



760 Horizon Drive, Suite 102
Grand Junction, CO 81506
P: 970.263.7800
F: 970.263.7456

Figure
3



The following disturbance area maps were included with this submittal.

(PL Carney 8-34 (1-4)) Carney 8-34 Tie In to CT Carney 7-35 Pipeline.vsd
(PL Carney 8-34 (1-4)) Carney 8-34 Tie In to CT Carney 7-35 Pipeline-removal.vsd
(PL Carney 8-34 (2-4)) CT Carney 7-35 to CT Carney 20X35 Pipeline.vsd
(PL Carney 8-34 (2-4)) CT Carney 7-35 to CT Carney 20X35 Pipeline-removal.vsd
(PL Carney 8-34 (3-4)) CT Carney 20X35 to FV Larson B-17X.vsd
(PL Carney 8-34 (3-4)) CT Carney 20X35 to FV Larson B-17X-removal.vsd
(PL Carney 8-34 (4-4)) FV Larson B-17X to Collection Station 39.vsd
(PL Carney 8-34 (4-4)) FV Larson B-17X to Collection Station 39-removal.vsd
A.C McLaughlin 34 to Tie-in Pipeline (Blue).vsd
A.C McLaughlin 34 to Tie-in Pipeline (Blue)-removal.vsd
A.C. McLaughlin 17 Pipeline to A.C. McLaughlin 91X (Yellow & Red).vsd
A.C. McLaughlin 17 Pipeline to A.C. McLaughlin 91X (Yellow & Red)-removal.vsd
AC McLaughlin 15 (1-10) West Water Plant to LN Hagood A2 (Red).vsd
AC McLaughlin 15 (1-10) West Water Plant to LN Hagood A2 (Red)-removal.vsd
AC McLaughlin 15 (2-10) LN Hagood A2 to Lateral Shut Off for LN Hagood 7(Red).vsd
AC McLaughlin 15 (2-10) LN Hagood A2 to Lateral Shut Off for LN Hagood 7(Red)-removal.vsd
AC McLaughlin 15 (3-10) Lateral Shut Off for LN Hagood 7 To AC McLaughlin 52X (Red) removal-.vsd
AC McLaughlin 15 (3-10) Lateral Shut Off for LN Hagood 7 To AC McLaughlin 52X (Red) rev.vsd
AC McLaughlin 15 (4-10) AC McLaughlin 52X to AC McLaughlin 8 (Red).vsd
AC McLaughlin 15 (4-10) AC McLaughlin 52X to AC McLaughlin 8 (Red)-removal.vsd
AC McLaughlin 15 (5-10) AC McLaughlin 8 AC McLaughlin 66X (Red).vsd
AC McLaughlin 15 (5-10) AC McLaughlin 8 AC McLaughlin 66X (Red)-removal.vsd
AC McLaughlin 15 (6-10) AC McLaughlin 66X to Pipe Riser (Red).vsd
AC McLaughlin 15 (6-10) AC McLaughlin 66X to Pipe Riser (Red)-removal.vsd
AC McLaughlin 15 (7-10) Pipe Riser to AC McLaughlin 28 (Red).vsd
AC McLaughlin 15 (7-10) Pipe Riser to AC McLaughlin 28 (Red)-removal.vsd
AC McLaughlin 15 (8-10) AC McLaughlin 28 to Collection Station 6 (Red).vsd
AC McLaughlin 15 (8-10) AC McLaughlin 28 to Collection Station 6 (Red)-removal.vsd
AC McLaughlin 15 (9-10).vsd
AC McLaughlin 15 (9-10)-removal.vsd
AC McLaughlin 15 (10-10).vsd
AC McLaughlin 15 (10-10)-removal.vsd
AC MCLAUGHLIN 31 TO AC MCLAUGHLIN 76X.vsd
AC MCLAUGHLIN 31 TO AC MCLAUGHLIN 76X-removal.vsd
AC McLaughlin 77X to Collection Station 3 (Blue).vsd
AC McLaughlin 77X to Collection Station 3 (Blue)-removal.vsd
AC McLaughlin Gray B8 PL.vsd

AC McLaughlin Gray B8 PL.vsd
AC McLaughlin Gray B8 PL-removal.vsd
C.T. Carney 19-34 To CS 30 (Blue).vsd
C.T. Carney 19-34 To CS 30 (Blue)-removal.vsd
CS 19 to A.C McLaughlin 3-32 (Blue).vsd
CS 19 to A.C McLaughlin 3-32 (Blue)-removal.vsd
Emerald 23 (1-2) to Main Line (Red).vsd
Emerald 23 (1-2) to Main Line (Red)-removal.vsd
Emerald 23 (2-2) Main Line to Emerald 35 (Red).vsd
Emerald 23 (2-2) Main Line to Emerald 35 (Red)-removal.vsd
Emerald 28 (1-2) to Emerald 63X (Red).vsd
Emerald 28 (1-2) to Emerald 63X (Red)-removal.vsd
Emerald 28 (2-2) Em 63X to Em 29AX (red)- removal.vsd
Emerald 28 (2-2) Em 63X to Em 29AX (red).vsd
EMERALD 56X TO CS 14 (GREEN).vsd
EMERALD 56X TO CS 14 (GREEN)-removal.vsd
Emerald 62X to Collection Station 6 (Blue).vsd
Emerald 62X to Collection Station 6 (Blue)-removal.vsd
Emerald 88X to CS 6 (Blue).vsd
Emerald 88X to CS 6 (Blue)-removal.vsd
Fee 49 to Union Pacific 39-17 Pipeline (Yellow).vsd
Fee 49 to Union Pacific 39-17 Pipeline (Yellow)-removal.vsd
Fee 61 to Collection Station 27 (Blue).vsd
Fee 61 to Collection Station 27 (Blue)-removal.vsd
Fee 108X to Collection Station 16 (Blue).vsd
Fee 108X to Collection Station 16 (Blue)-removal.vsd
Fee 143X to Header West of Fee 139X.vsd
Fee 143X to Header West of Fee 139X-removal.vsd
Fee 157X to Collection Station 20.vsd
Fee 157X to Collection Station 20-removal.vsd
FV LARSON B11 C.T CARNEY 15-35 TO C.T. CARNEY 35X34 TIE IN (6-6) (RED).vsd
FV LARSON B11 C.T CARNEY 15-35 TO C.T. CARNEY 35X34 TIE IN (6-6) (RED)-removal.vsd
FV LARSON B11 FV LARSON B5 SHUT OFF VALVE TO WATER LATERAL SHUT OFF FV LARSON B10 (3-6) (RED).vsd
FV LARSON B11 FV LARSON B5 SHUT OFF VALVE TO WATER LATERAL SHUT OFF FV LARSON B10 (3-6) (RED)-removal.vsd
FV LARSON B11 FV LARSON B5 TO FV LARSON B5 SHUT OFF VALVE (2-6) (RED).vsd
FV LARSON B11 FV LARSON B5 TO FV LARSON B5 SHUT OFF VALVE (2-6) (RED)-removal.vsd
FV LARSON B11 TO FV LARSON B5 (1-6) (RED).vsd
FV LARSON B11 TO FV LARSON B5 (1-6) (RED)-removal.vsd

FV LARSON B11 TO FV LARSON B17X TO C.T CARNEY 15-35 (5-6) (RED).vsd
FV LARSON B11 TO FV LARSON B17X TO C.T CARNEY 15-35 (5-6) (RED)-removal.vsd
FV LARSON B11 WATER LATERAL SHUT OFF FV LARSON B10 TO FV LARSON B17X (4-6) (RED).vsd
FV LARSON B11 WATER LATERAL SHUT OFF FV LARSON B10 TO FV LARSON B17X (4-6) (RED)-removal.vsd
HAGOOD MC A9 TO AC MCLAUGHLIN 15.vsd
HAGOOD MC A9 TO AC MCLAUGHLIN 15-removal.vsd
HAGOOD MC A9 TO HAGOODMC A4.vsd
HAGOOD MC A9 TO HAGOODMC A4-removal.vsd
LEVISON 8 (1-2) to Levison 12.vsd
LEVISON 8 (1-2) to Levison 12-removal.vsd
LEVISON 8 (2-2) Levison 12 to Levison 17.vsd
LEVISON 8 (2-2) Levison 12 to Levison 17-removal.vsd
M.B. Larson C 2-25 and Access.vsd
M.B. Larson C 2-25 and Access-removal.vsd
PL AC McLaughlin 44 to AC McLaughlin 46.vsd
PL AC McLaughlin 44 to AC McLaughlin 46-removal.vsd
PL disturbance FV Larson B5.vsd
PL disturbance FV Larson B5-removal.vsd
PL Emerald 28 (2-2) Emerald 63X to Emerald 29AX (Red).vsd
PL Fee 19 to Collection Station 27 (Blue).vsd
PL Fee 19 to Collection Station 27 (Blue)-removal.vsd
PL Fee 144Y to Collection Station 22 (Blue).vsd
PL Fee 144Y to Collection Station 22 (Blue)-removal.vsd
PL Fee 158X.vsd
PL Fee 158X-removal.vsd
PL Magor 1.vsd
PL Magor 1-removal.vsd
PL Union Pacific 20-29 to Fee 52 (Red & Yellow).vsd
PL Union Pacific 20-29 to Fee 52 (Red & Yellow)-removal.vsd
SH McLaughlin 2-28 to CS 28 (Blue).vsd
SH McLaughlin 2-28 to CS 28 (Blue)-removal.vsd
Union Pacific 32-27, UP 69-27 and UP 140Y27 to Collection Station 29 (2 PL).vsd
Union Pacific 32-27, UP 69-27 and UP 140Y27 to Collection Station 29 (2 PL)-removal.vsd
Union Pacific 39-17 to Union Pacific 55-17.vsd
Union Pacific 39-17 to Union Pacific 55-17-removal.vsd
Union Pacific 56-21 (1-6) to Union Pacific 78X21 (Red).vsd
Union Pacific 56-21 (1-6) to Union Pacific 78X21 (Red)-removal.vsd
Union Pacific 56-21 (2-6) Union Pacific 78X21 to Union Pacific 10-21 (Red).vsd

Union Pacific 56-21 (2-6) Union Pacific 78X21 to Union Pacific 10-21 (Red)-removal.vsd
Union Pacific 56-21 (3-6) Union Pacific 10-21 to Union Pacific 15-28.vsd
Union Pacific 56-21 (3-6) Union Pacific 10-21 to Union Pacific 15-28-removal.vsd
Union Pacific 56-21 (4-6) Union Pacific 15-28 to Union Pacific 19-28 (Red).vsd
Union Pacific 56-21 (4-6) Union Pacific 15-28 to Union Pacific 19-28 (Red)-removal.vsd
Union Pacific 56-21 (5-6) Union Pacific 19-28 to Fee 83X (Red).vsd
Union Pacific 56-21 (5-6) Union Pacific 19-28 to Fee 83X (Red)-removal.vsd
Union Pacific 56-21 (6-6) Fee 83X to Fee 144Y (Red).vsd
Union Pacific 56-21 (6-6) Fee 83X to Fee 144Y (Red)-removal.vsd
Union Pacific 56-21 to Disturbance of Drainage Area.vsd
Union Pacific 115X-21 to Collection Station 20.vsd
Union Pacific 115X-21 to Collection Station 20-removal.vsd
Union Pacific 118X-21 to Collection Station 20.vsd
Union Pacific 118X-21 to Collection Station 20-removal.vsd
Union Pacific 142Y28 to CS 22.vsd
Union Pacific 142Y28 to CS 22-removal.vsd
WEYRAUCH 7X36 TO WATER STATION 46.vsd
WEYRAUCH 7X36 TO WATER STATION 46-removal.vsd

Received

JUN 16 2016

**COLORADO****Department of Public
Health & Environment****Water Quality Control**Dedicated to protecting and improving the health and environment of the people of
Colorado**For Agency Use Only**

Date Received ____/____/____

Effective Date ____/____/____

CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS, AND AUTHORIZATIONS

MAIL TO:

CDPHE WQCD Mail Code WQC-PCP-2034
4300 Cherry Creek Dr South Denver CO 80246

This form must be submitted for changes made to any of the contacts or information listed below.

PHOTO COPIES, FAXED COPIES, PDF COPIES OR EMAILS WILL NOT BE ACCEPTED.**PERMIT, CERTIFICATION, OR AUTHORIZATION NUMBER** COR03F434 (This number does not end in 0000)

(A separate form must be prepared for each Permit, Certification, or Authorization covered by these changes.)

PERMITTEE ORGANIZATION FORMAL NAME (If more than one please add additional pages) :Chevron USA inc.

The legally responsible organization is either the owner or operator of the facility or project to which the permit has been issued, or both if designated as co-permittees by the Division.

FACILITY NAME Rangely Weber Sand Unit Field**ENTER ALL OF THE INFORMATION FOR EACH CONTACT WHERE THERE IS A CHANGE.**

1. **PERMITTEE** the person authorized to sign and certify the permit application. This person receives all permit correspondences and is legally responsible for compliance with the permit.

Responsible Position (title) SuperintendentHeld by (person) Nick MoschettiTelephone # 970-675-3846 email address nmos@chevron.comOrganization Chevron North American E&P Company-MidContinent SBU-OperationsMailing address 100 Chevron RoadCity Rangely State CO Zip 81648This form must be signed by the Permittee to be considered complete.**Per Regulation 61** In all cases, it shall be signed as follows:

- In the case of corporations, by a responsible corporate officer. For the purposes of this section, the responsible corporate officer is responsible for the overall operation of the facility from which the discharge described in the application originates.
- In the case of a partnership, by a general partner.
- In the case of a sole proprietorship, by the proprietor.
- In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official

Revised 4/1/2015



CHANGE OF CONTACT(S) FOR ALL PERMITS, CERTIFICATIONS AND AUTHORIZATIONS

2. **DMR COGNIZANT OFFICIAL** (i.e. authorized agent) the person authorized to sign and certify the Reports as required by the permit, including Discharge Monitoring Reports (DMR's), Annual Reports, Compliance Schedule submittals, and other information requested by the Division. The Division will transmit pre-printed reports (i.e. DMR's) to this person. If more than one person, please add additional pages. **This party may not sign application forms.**

Responsible Position (title) Same as Permittee
Held by (person) _____
Telephone # _____ email address _____
Organization _____
Mailing address _____
City _____ State _____ Zip _____

3. **SITE CONTACT** local contact for questions relating to the facility and discharge authorized by this permit for the facility

Responsible Position (title) HES Specialist
Held by (person) Mike Haub
Telephone # 970-675-3814 email address mhaub@chevron.com
Organization Chevron North American E&P-MidContinent SBU-HES
Mailing address Rangely FMT 100 Chevron RD
City Rangely State CO Zip 81648

4. **CERTIFIED OPERATOR IN RESPONSIBLE CHARGE (ORC)** may designate on or both if needed

A. Wastewater Treatment Facility ORC

Operator ID Number Not Applicable
Legal Name _____
Telephone # _____ email address _____
Organization _____
Mailing address _____
City _____ State _____ Zip _____

B. Wasterwater Collection System ORC

Operator ID Number Not Applicable
Legal Name _____
Telephone # _____ email address _____
Organization _____
Mailing address _____
City _____ State _____ Zip _____

CHANGE OF CONTACT(S) FOR ALL PERMITS, CERTIFICATIONS AND AUTHORIZATIONS

5. BILLING CONTACT if different than permittee

Responsible Position (title) Same as Permittee

Held by (person) _____

Telephone # _____ email address _____

Organization _____

Mailing address _____

City _____ State _____ Zip _____

6. OTHER CONTACT TYPES (check below) Add pages if necessary.

Responsible Position (title) Stormwater InspectorHeld by (person) Danielle WilkinsonTelephone # 970-263-7800 email address dwilkinson@olssonassociates.comOrganization Olsson AssociatesMailing address 760 Horizon Drive Suite 102City Grand Junction State CO Zip 81506☐

Pretreatment Coordinator

☐

Environmental Contact

☐

Biosolids Responsible Party

☐

Inspection Facility Contact

☒

Consultant

☐

Compliance Contact

☐

Stormwater MS4 Responsible Party

☐

Stormwater Authorized Representative

☐

Property Owner

☐

Other _____

REQUIRED CERTIFICATION SIGNATURE [Reg 61.4(1)(h)]

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature (Legally Responsible Party) Nick MoschettiDate 6/7/2016Name (printed) Nick MoschettiTitle Superintendent

STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC
HEALTH AND ENVIRONMENT
Water Quality Control Division
4300 Cherry Creek Drive South B2 Permits
Denver, Colorado 80246-1530

Received
MAR 10 2014
Water Quality Control



Colorado Department
of Public Health
and Environment

For Agency Use Only

Date Received ____/____/____

Effective Date ____/____/____

CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS, AND AUTHORIZATIONS

This form must be submitted for changes made to any of the contacts or information listed below.

PHOTO COPIES, FAXED COPIES, PDF COPIES OR EMAILS WILL NOT BE ACCEPTED.

PERMIT, CERTIFICATION, OR AUTHORIZATION NUMBER COR03F434 (This number does not end in 0000)
(A separate form must be prepared for each Permit, Certification, or Authorization covered by these changes.)

PERMITTEE (If more than one please add additional pages)

ORGANIZATION FORMAL NAME: Chevron USA Inc.

The legally responsible organization is either the owner or operator of the facility or project to which the permit has been issued, or both if designated as co-permittees by the Division.

FACILITY NAME Rangely Weber Sand Unit

ENTER THE ALL OF THE INFORMATION FOR EACH CONTACT WHERE THERE IS A CHANGE.

- 1) **PERMITTEE** the person **authorized to sign and certify** the permit application. This person receives all permit correspondences and is **legally responsible** for compliance with the permit.

Responsible Position (Title): Operations Supervisor

Currently Held By (Person): Luke Allred

Telephone No: 970-675-3846

email address luci@chevron.com

Organization: Chevron USA, Inc.

Mailing Address: 100 Chevron Road

City: Rangely State: CO Zip: 81648

This form must be signed by the Permittee to be considered complete.

Per Regulation 61 In all cases, it shall be signed as follows:

- In the case of corporations, by a responsible corporate officer. For the purposes of this section, the responsible corporate officer is responsible for the overall operation of the facility from which the discharge described in the application originates.
- In the case of a partnership, by a general partner.
- In the case of a sole proprietorship, by the proprietor.
- In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official

CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS, AND AUTHORIZATIONS

- 2) **DMR COGNIZANT OFFICIAL (i.e. authorized agent)** the person or position authorized to sign and certify reports required by permits including Discharge Monitoring Reports [DMR's], Annual Reports, Compliance Schedule submittals, and other information requested by the Division. The Division will transmit pre-printed reports (ie. DMR's) to this person. If more than one, please add additional pages.

Responsible Position (Title): Operations Supervisor
Currently Held By (Person): Luke Allred
Telephone No: 970-675-3846
email address luci@chevron.com
Organization: Chevron USA, Inc.
Mailing Address: 100 Chevron Road
City: Rangely State: CO Zip: 81648

Per Regulation 61 : All reports required by permits, and other information requested by the Division shall be signed by the permittee or by a duly authorized representative of that person. A person is a duly authorized representative only if:

- (i) The authorization is made in writing by the permittee
- (ii) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a **named individual** or any individual occupying a **named position**); and
- (iii) The written authorization is submitted to the Division

- 3) **SITE CONTACT** local contact for questions relating to the facility & discharge authorized by this permit for the facility.

Responsible Position (Title): HE Specialist
Currently Held By (Person): Tammie Lee Crossen
Telephone No: 970-675-3705
email address tvzf@chevron.com
Organization: Chevron USA, Inc.
Mailing Address: 100 Chevron Road
City: Rangely State: CO Zip: 81648

- 4) **OPERATOR in Responsible Charge**

Responsible Position (Title): Operations Supervisor
Currently Held By (Person): Luke Allred
Telephone No: 970-675-3846
email address luci@chevron.com
Organization: Chevron USA, Inc.
Mailing Address: 100 Chevron Road
City: Rangely State: CO Zip: 81648
Certification Type _____ Certification Number _____

CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS, AND AUTHORIZATIONS**5) BILLING CONTACT** if different than the permitteeResponsible Position (Title): same as permittee

Held By (Person): _____

Telephone No: _____

email address _____

Organization: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

6) OTHER CONTACT TYPES (check below) Add pages if necessary:Responsible Position (Title): Stormwater ManagerHeld By (Person): Kenneth GonzalesTelephone No: 970-263-6010email address kgonzales@olssonassociates.comOrganization: Olsson AssociatesMailing Address: 760 Horizon Drive, Suite 102City: Grand Junction State: CO Zip: 81506☐ Pretreatment Coordinator☐ Environmental Contact☐ Biosolids Responsible Party☐ Inspection Facility Contact☒ Consultant☐ Compliance Contact☐ Stormwater MS4 Responsible Person☒ Stormwater Authorized Representative☐ Property Owner☐ Other _____**REQUIRED CERTIFICATION SIGNATURE [Reg 61.4(1)(h)]**

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature (Legally Responsible Party) _____

Date 3-4-14Name (printed) Luke AllredTitle Operations Supervisor

STATE OF COLORADO

RECEIVEDColorado Department
of Public Health
and EnvironmentCOLORADO DEPARTMENT OF PUBLIC
HEALTH AND ENVIRONMENT
Water Quality Control Division
4300 Cherry Creek Drive South B2 Permits
Denver, Colorado 80246-1530

DEC 17 2013

WATER QUALITY CONTROL DIVISION

For Agency Use Only

Date Received ____/____/____

Effective Date ____/____/____

**CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS,
AND AUTHORIZATIONS**This form must be submitted for changes made to any of the contacts or information listed below.
PHOTO COPIES, FAXED COPIES, PDF COPIES OR EMAILS WILL NOT BE ACCEPTED.PERMIT, CERTIFICATION, OR AUTHORIZATION NUMBER COR03F434 (This number does not end in 0000)
(A separate form must be prepared for each Permit, Certification, or Authorization covered by these changes.)

PERMITTEE (If more than one please add additional pages)

ORGANIZATION FORMAL NAME: Chevron USA Inc.

The legally responsible organization is either the owner or operator of the facility or project to which the permit has been issued, or both if designated as co-permittees by the Division.

FACILITY NAME Rangely Weber Sand Unit Field

ENTER ALL OF THE INFORMATION FOR EACH CONTACT WHERE THERE IS A CHANGE.

- 1) **PERMITTEE** the person authorized to sign and certify the permit application. This person receives all permit correspondences and is legally responsible for compliance with the permit.

Responsible Position (Title): Operations SupervisorHeld By (Person): Luke AllredTelephone No: 970-675-3846email address LUCI@chevron.comOrganization: Chevron North America E&P Company - MidContinent SBU - OperationsMailing Address: 100 Chevron RdCity: Rangely State: CO Zip: 81648This form must be signed by the Permittee to be considered complete.Per Regulation 61 In all cases, it shall be signed as follows:

- In the case of corporations, by a responsible corporate officer. For the purposes of this section, the responsible corporate officer is responsible for the overall operation of the facility from which the discharge described in the application originates.
- In the case of a partnership, by a general partner.
- In the case of a sole proprietorship, by the proprietor.
- In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official

CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS, AND AUTHORIZATIONS

- 2) **DMR COGNIZANT OFFICIAL (i.e. authorized agent)** the person or position authorized to **sign and certify** reports required by permits including Discharge Monitoring Reports [DMR's], Annual Reports, Compliance Schedule submittals, and other information requested by the Division. The Division will transmit pre-printed reports (ie. DMR's) to this person. If more than one, please add additional pages.

Responsible Position (Title): same as permittee

Held By (Person): _____

Telephone No: _____

email address _____

Organization: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

Per Regulation 61 : All reports required by permits, and other information requested by the Division shall be signed by the permittee or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(i) The authorization is made in writing by the permittee

(ii) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a **named individual** or any individual occupying a **named position**); and

(iii) The written authorization is submitted to the Division

- 3) **SITE CONTACT** local contact for questions relating to the facility & discharge authorized by this permit for the facility.

Responsible Position (Title): HE Specialist

Held By (Person): Tammie Lee Crossen

Telephone No: 970-675-3705

email address TVZF@chevron.com

Organization: Chevron North America E&P - MidContinent SBU - HES

Mailing Address: Rangely FMT 100 Chevron Rd

City: Rangely State: CO Zip: 81648

- 4) **OPERATOR in Responsible Charge**

Responsible Position (Title): same as permittee

Held By (Person): _____

Telephone No: _____

email address _____

Organization: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

Certification Type _____ Certification Number _____

CHANGE OF CONTACT(s) for all PERMITS, CERTIFICATIONS, AND AUTHORIZATIONS**5) BILLING CONTACT** if different than the permitteeResponsible Position (Title): same as permittee

Held By (Person): _____

Telephone No: _____

email address _____

Organization: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

6) OTHER CONTACT TYPES (check below) Add pages if necessary:Responsible Position (Title): Stormwater ManagerHeld By (Person): Kenneth GonzalesTelephone No: 970-263-6010email address kgonzales@olssonassociates.comOrganization: Olsson AssociatesMailing Address: 760 Horizon Drive, Suite 102City: Grand Junction State: CO Zip: 81506☐ Pretreatment Coordinator☐ Environmental Contact☐ Biosolids Responsible Party☐ Inspection Facility Contact☒ Consultant☐ Compliance Contact☐ Stormwater MS4 Responsible Person☒ Stormwater Authorized Representative☐ Property Owner☐ Other _____**REQUIRED CERTIFICATION SIGNATURE [Reg 61.4(1)(h)]**

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature (Legally Responsible Party) _____

Date 10-29-13Name (printed) Luke AllredTitle Operations Supervisor

STATE OF COLORADO

John W. Hickenlooper, Governor
Christopher E. Urbina, MD, MPH
Executive Director and Chief Medical Officer

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S. Laboratory Services Division
Denver, Colorado 80246-1530 8100 Lowry Blvd.
Phone (303) 692-2000 Denver, Colorado 80230-6928
Located in Glendale, Colorado (303) 692-3090

<http://www.cdphe.state.co.us>



Colorado Department
of Public Health
and Environment

June 21, 2012

Luke Allred, Ops Sup
Chevron USA Inc
100 Chevron Rd
Rangely, CO 81648

**RE: Renewal of Permit/Certification
Administrative Continuation
For: Rangely Weber Sand Unit Field Permit
Located at: SH 64 & SH 139 NW of Rangely, Rangely, Rio Blanco County
Permit No.: COR03F434**

Dear Mr. Allred;

The Division has received an application to renew the above permit/certification. It has been determined that there is sufficient information to make this permit/certification eligible for renewal. More information may be requested by the Division as progress is made in developing a new permit/certification for the above listed facility. This information must be made available to the Division when requested to complete the permit process.

The Division is currently in the process of developing a new permit or master general permit and associated certification for the above permitted facility. The development and review procedures required by law have not yet been completed. When the discharge permit issued to you for your facility expired on **June 30, 2012** your permit is administratively continued and remains in effect under Section 104(7) of the Administrative Procedures Act, C.R.S. 1973, 24-4-101, et seq (1982 repl. vol. 10) until the new permit/certification is issued and effective.

All effluent permit terms and conditions in your current permit will remain in effect until your new permit/certification is issued and effective.

**PLEASE KEEP THIS LETTER WITH YOUR PERMIT AND SWMP TO SHOW
CONTINUATION OF PERMIT COVERAGE.**

Sincerely,

Debbie Jessop
Permits Section
WATER QUALITY CONTROL DIVISION

xc: Permit File

STATE OF COLORADO

RECEIVED

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4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado
<http://www.cdphe.state.co.us>

MAR 08 2012



Colorado Department
of Public Health
and Environment

WATER QUALITY CONTROL DIVISION

RENEWAL COLORADO DISCHARGE
PERMIT SYSTEM (CDPS)
STORMWATER DISCHARGE ASSOCIATED
WITH CONSTRUCTION ACTIVITIES
APPLICATION Permit COR030000

Rec'd by Division

F434

_____/_____/2012

THE CDPS GENERAL PERMIT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES (COR030000) WILL EXPIRE JUNE 30, 2012 AND WILL BE ADMINISTRATIVELY CONTINUED AT THAT TIME.

- FOR CERTIFICATION TO BE ADMINISTRATIVELY CONTINUED, THIS APPLICATION MUST BE REVIEWED, CORRECTED (if needed), SIGNED, AND RETURNED TO THE DIVISION PRIOR TO APRIL 1, 2012. This is the only action necessary to renew this certification.
- IF CERTIFICATION IS NO LONGER NEEDED, PLEASE SEND IN AN INACTIVATION FORM AS SOON AS THE FACILITY IS ELIGIBLE.

- Receipt of this form will be tracked on the division's web site:

<http://www.cdphe.state.co.us/wq/PermitsUnit/construction.html>.

Select: *Active Stormwater Construction Certifications* (this list will be updated in the first week of each month). A date entry under "Application Received" indicates the date the Division received this renewal application. This also indicates that the certification is administratively continued.

- A postcard will be sent to confirm a certification is administratively continued.
- Certifications for which no renewal is received will expire and be terminated effective June 30, 2012.

- Please keep a copy of this application for your records.

Please direct questions to cdphe.wqstorm@state.co.us, (303) 692-3517, or visit our website at www.coloradowaterpermits.com.

Mail to: CDPHE/WQCD Attn Permits.

4300 Cherry Creek Dr South

Denver CO 80246

Photo copies, faxed copies, pdf copies or emails will not be accepted by the Division.

APPLICATION to RENEW CERT # COR03 F434 (not 0000)

PERMITTEE ORGANIZATION FORMAL NAME Chevron USA Inc.

LEGAL CONTACT This form must be signed by this party to be considered complete.

Name Luke Allred, Operations Supervisor

Phone 970-675-3846

Email LUCI@chevron.com

Mailing Address: 100 Chevron Rd

City: Rangely

State: CO

Zip: 81648

LOCAL CONTACT

Name E Faithe Schwartzengraber, HE Specialist

Phone 970-675-3705

Email EFSC@chevron.com

Organization: Chevron North America E&P - MidContinent SBU - HES

Mailing Address: 100 Chevron Rd

City: Rangely

State: CO

Zip: 81648

BILLING CONTACT

Name Luke Allred, Operations Supervisor

Phone 970-675-3846

Email LUCI@chevron.com

Organization: Chevron North America E&P Company - MidContinent SBU - Operations

Mailing Address: 100 Chevron Rd

City: Rangely

State: CO

Zip: 81648

OWNER (NOT REQUIRED)

Name _____

Phone _____

Email _____

Organization: _____

Mailing Address: _____

City: _____

State: _____

Zip: _____

PERMITTED PROJECT/FACILITY INFORMATION :

To check for current information recorded by the Division, a spreadsheet of all current certifications with all of the information required on this application is available on the Permitting website www.coloradowaterpermits.com under Construction Activities.

Project/Facility Name Rangely Weber Sand Unit Field Permit

Address or cross streets SH64 & SH139 NW of Rangely

City Rangely County Rio Blanco Zip Code 81648

Facility Latitude 40/07/00 Longitude -108/52/00

Total area of project site (acres): 19,143 Area of disturbance (acres) 54

Nature of Construction Activity

Oil and Gas Production and/or Exploration.

Immediate Receiving Water(s): Stinking Water Creek

Ultimate Receiving Water(s): White River

SIGNATURE OF PERMIT LEGAL CONTACT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

"I understand that submittal of this application is for coverage under the State of Colorado General Permit for Stormwater Discharges Associated with Construction Activity for the entirety of the construction site/project described and applied for, until such time as the application is amended or the certification is transferred, inactivated, or expired."

XX

Signature of Legally Responsible Person (submission must include original signature)

Date Signed

Luke Allred

Operations Supervisor

Name (printed)

Title

Per Regulation 61 In all cases, APPLICATION shall be signed as follows:

- In the case of corporations, by a responsible corporate officer. For the purposes of this section, the responsible corporate officer is responsible for the overall operation of the facility from which the discharge described in the application originates.
- In the case of a partnership, by a general partner.
- In the case of a sole proprietorship, by the proprietor.
- In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

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Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

<http://www.cdphe.state.co.us>



Colorado Department
of Public Health
and Environment

August 18, 2009

Luke Allred, Ops Sup
Chevron USA, Inc
100 Chevron Rd
Rangely, CO 81648

RE: Certification, Colorado Discharge Permit System
Permit No., COR030000, Certification Number: COR03F434

Dear Mr./Ms. Allred;

The Water Quality Control Division (the Division) has reviewed the application submitted for the Rangely Weber Sand Unit Field Permit facility and determined that it qualifies for coverage under the CDPS General Permit for Stormwater Discharges Associated with Construction (the permit). Enclosed please find a copy of the permit certification, which was issued under the Colorado Water Quality Control Act.

Facility: Rangely Weber Sand Unit Field Permit
Legal Contact: Luke Allred, Ops Sup

Rio Blanco County
Phone number: 970-675-3846
Email: luci@chevron.com
Phone number: 970-675-3839
Email: wshb@chevron.com

Facility Contact: Bill Savage, HES Specialist

Luke Allred, is the legal contact for this certification, as shown above. The legal contact receives all legal documentation pertaining to the permit certification, including invoices. Bill Savage is the local contact as listed above. This entity will be contacted for general inquiries regarding the facility.

The Annual Fee for this certification is \$245.00 is invoiced every July. Do Not Pay This Now. The initial prorated invoice will be sent to the legal contact shortly.

Please read the enclosed permit and certification. If you have any questions please contact Kathy Rosow, Environmental Protection Specialist, at (303) 692-3521.

Sincerely,

A handwritten signature in cursive script, appearing to read "Debbie Jessop".

Debbie Jessop, Administrative Assistant
WATER QUALITY CONTROL DIVISION

Enclosures: Certification page; General Permit; Highlight Sheet; Termination form

xc: Regional Council of Government
Rio Blanco County, Local County Health Department
D.E., Technical Services Unit, WQCD
Permit File

/dkj

cert

STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
WATER QUALITY CONTROL DIVISION
TELEPHONE: (303) 692-3500



**CERTIFICATION TO DISCHARGE
UNDER
CDPS GENERAL PERMIT COR-0300000
STORMWATER ASSOCIATED WITH CONSTRUCTION ACTIVITIES**

Certification Number: **COR03F434**

This Certification to Discharge specifically authorizes:

Chevron USA, Inc

to discharge stormwater from the facility identified as

Rangely Weber Sand Unit Field Permit

to:

Stinking Water Creek - White River

Facility Industrial Activity : Oil and Gas Production and/or Exploration,

Facility Located at: SH 64 & SH 139 NW of Rangely, Rangely
Rio Blanco County, CO
Latitude 40/07/00, Longitude -108/52/00

Certification is effective: 8/18/2009

Certification Expires: 6/30/2012

This certification under the permit requires that specific actions be performed at designated times. The certification holder is legally obligated to comply with all terms and conditions of the permit.

Signed,

Nathan Moore
Stormwater Work Group Leader
Water Quality Control Division

STATE OF COLORADO

Bill Ritter, Jr., Governor
James B. Martin, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
TDD Line (303) 691-7700
Located in Glendale, Colorado
<http://www.cdphs.state.co.us>

RECEIVED

AUG 13 2009

WATER QUALITY CONTROL DIVISION



Colorado Department
of Public Health
and Environment

For Agency Use Only

Permit Number Assigned

COR03- **P434**

Date Received ____/____/____
Month Day Year

A

STORMWATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITIES APPLICATION

Please print or type. Original ink signatures are required. This application must be considered complete by the Division before it will initiate permit processing. The Division will notify the applicant if additional information is needed to complete the application. If more space is required to answer any question, please attach additional sheets to the application form. Applications must be mailed or delivered to:

**Colorado Department of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Drive South
WQCD-P-B2
Denver, Colorado 80246-1530**

FAXES AND PDF COPIES WILL NOT BE ACCEPTED.

PERMIT INFORMATION

Applicant is: ☒ Property Owner ☐ Contractor/Operator

1. CONTACT INFORMATION

➤ Permit Applicant

Company Name: Chevron USA, Inc

Legally Responsible Person: First Name: Luke Last Name: Allred

Title: Operations Supervisor

Mailing Address: 100 Chevron Road

City, State and Zip Code: Rangely, Co 81648

Phone: 970-675-3846

Email Address: LUCI@chevron.com

➤ Local Facility Contact ☐ Same as Applicant

Local Contact Person: First Name: Bill Last Name: Savage

Title: HES Specialist

Phone: 970-675-3839

Email Address: WSHB@chevron.com

➤ Billing Contact ☒ Same as Applicant Company Name

Billing Contact Person: First Name: Last Name:

Title:

Mailing Address:

City, State and Zip Code:

Phone:

Email Address:

2. PERMITTED FACILITY INFORMATION

Name of Plan, Project or Development: Rangely Weber Sand Unit Field-Wide Permit

Location of construction site:

Street Address (or cross streets): 5 miles Northwest of Rangely SHWY 64 & SH 139

City (if unincorporated, so indicate): Nearest-Rangely County: Rio Blanco

State and Zip Code: Colorado, 81648

Latitude and Longitude (approximate center of site to nearest 15 seconds using one of following formats):

Latitude: 40/07/00 Longitude: 108/52/00 (e.g., 39°42'11", 104°55'57")

degrees /minutes/ seconds degrees/ minutes/ seconds

OR

Latitude: degrees (to 3 decimal places) Longitude: degrees (to 3 decimal places) (e.g., 39.703°, 104.933')

3. MAP (Attachment)

Map: Attach a map that indicates the site location and that CLEARLY shows the boundaries of the area that will be disturbed. Maps must be no larger than 11x17 inches.

4. LEGAL DESCRIPTION

Legal description: If subdivided, provide the legal description below, or indicate that it is not applicable (do not supply Township/Range/Section or metes and bounds description of site)

Subdivision(s): Map Attachment Lot(s): Block(s):

OR

☒ Not applicable (site has not been subdivided)

5. AREA OF CONSTRUCTION SITE

Total area of project site (acres): 19,143 Acres

Area of project site to undergo disturbance (acres): 19,143 Acres

Total disturbed area of Larger Common Plan of Development or Sale, if applicable: 54 Acres

(i.e., total, including all phases, filings, lots, and infrastructure not covered by this application)

6. NATURE OF CONSTRUCTION ACTIVITY

Check the appropriate box(s) or provide a brief description that indicates the general nature of the construction activities. (The full description of activities must be included in the Stormwater Management Plan.)

☐ Single Family Residential Development

☐ Multi-Family Residential Development

☐ Commercial Development

☒ Oil and Gas Production and/or Exploration (including pad sites and associated infrastructure)

☐ Highway/Road Development (not including roadways associated with commercial or residential development)

☐ Other, Describe:

7. ANTICIPATED CONSTRUCTION SCHEDULE

Construction Start Date: 8/18/09 Final Stabilization Date: Ongoing

8. RECEIVING WATERS (If discharge is to a ditch or storm sewer, include the name of the ultimate receiving waters)

Immediate Receiving Water(s): Stinking Water Creek

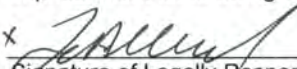
Ultimate Receiving Water(s): White River

9. REQUIRED SIGNATURES (Both parts i. and ii. must be signed)

STOP! A Stormwater Management Plan must be completed prior to signing the following certifications!

i. Stormwater Management Plan Certification

"I certify under penalty of law that a complete Stormwater Management Plan, as described in Appendix A of this application, has been prepared for my activity. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the Stormwater Management Plan is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for falsely certifying the completion of said SWMP, including the possibility of fine and imprisonment for knowing violations."

x 

8/11/09

Signature of Legally Responsible Person (submission must include original ink signature)

Luke Allred

Name (printed)

Date Signed

Operations Supervisor

Title

ii. Signature of Permit Legal Contact

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment."

"I understand that submittal of this application is for coverage under the State of Colorado General Permit for Stormwater Discharges Associated with Construction Activity **for the entirety of the construction site/project described and applied for, until such time as the application is amended or the certification is transferred, inactivated, or expired.**"

x 

8/11/09

Signature of Legally Responsible Person (submission must include original ink signature)

Luke Allred

Name (printed)

Date Signed

Operations Supervisor

Title

DO NOT INCLUDE A COPY OF THE STORMWATER MANAGEMENT PLAN

DO NOT INCLUDE PAYMENT – AN INVOICE WILL BE SENT AFTER THE CERTIFICATION IS ISSUED.

Receiving Waters for Chevron Rangely Weber Sand Unit

Various un-named drainages to Coal Oil Gulch to Stinking Water Creek to White River. Un-named drainages to Nate Spring Draw, to Stinking Water Creek to White River. Un-named drainages to Dead Dog Draw to White River. Un-named drainages to Stinking Water Creek to White River. Un-named drainages to White River.

Site specific maps will contain the actual drainage path for each specific site. All areas are contained within the aforementioned receiving waters.

CDPS GENERAL PERMIT
STORMWATER DISCHARGES ASSOCIATED WITH
CONSTRUCTION ACTIVITY
AUTHORIZATION TO DISCHARGE UNDER THE
COLORADO DISCHARGE PERMIT SYSTEM


In compliance with the provisions of the Colorado Water Quality Control Act, (25-8-101 et seq., CRS, 1973 as amended) and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.; the "Act"), this permit authorizes the discharge of stormwater associated with construction activities (and specific allowable non-stormwater discharges in accordance with Part I.D.3 of the permit) certified under this permit, from those locations specified throughout the State of Colorado to specified waters of the State. Such discharges shall be in accordance with the conditions of this permit.

This permit specifically authorizes the facility listed on the certification page (page 1) of this permit to discharge, as of this date, in accordance with permit requirements and conditions set forth in Parts I and II hereof. All discharges authorized herein shall be consistent with the terms and conditions of this permit.

This permit and the authorization to discharge shall expire at midnight, **June 30, 2012.**

Issued and Signed this 31st day of May, 2007

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT



Janet S. Kieler
Permits Section Manager
Water Quality Control Division

SIGNED AND ISSUED MAY 31, 2007

EFFECTIVE JULY 1, 2007

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PART I

A. COVERAGE UNDER THIS PERMIT

1. **Authority to Discharge**

Under this permit, facilities are granted authorization to discharge stormwater associated with construction activities into waters of the state of Colorado. This permit also authorizes the discharge of specific allowable non-stormwater discharges, in accordance with Part I.D.3 of the permit, which includes discharges to the ground. This includes stormwater discharges from areas that are dedicated to producing earthen materials, such as soils, sand and gravel, for use at a single construction site (i.e., borrow or fill areas). This permit also authorizes stormwater discharges from dedicated asphalt batch plants and dedicated concrete batch plants. (Coverage under the construction site permit is not required for batch plants if they have alternate CDPS permit coverage.) This permit does not authorize the discharge of mine water or process water from such areas.

- a) **Applicable Sections:** In accordance with Part I.A.3 of this permit, some parts of this permit do not apply to sites covered under a Qualifying Local Program, as defined in I.A.2.d. For sites not covered by a Qualifying Local Program, all parts of the permit apply except Part I.A.3. The permittee will be responsible for determining and then complying with the applicable sections.
- b) **Oil and Gas Construction:** Stormwater discharges associated with construction activities directly related to oil and gas exploration, production, processing, and treatment operations or transmission facilities are regulated under the Colorado Discharge Permit System Regulations (5CCR 1002-61), and require coverage under this permit in accordance with that regulation. However, references in this permit to specific authority under the Federal Clean Water Act (CWA) do not apply to stormwater discharges associated with these oil and gas related construction activities, to the extent that the references are limited by the federal Energy Policy Act of 2005.

2. **Definitions**

- a) **Stormwater:** Stormwater is precipitation-induced surface runoff.
- b) **Construction activity:** Construction activity refers to ground surface disturbing activities, which include, but are not limited to, clearing, grading, excavation, demolition, installation of new or improved haul roads and access roads, staging areas, stockpiling of fill materials, and borrow areas. Construction does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility.
- c) **Small construction activity:** Stormwater discharge associated with small construction activity means the discharge of stormwater from construction activities that result in land disturbance of equal to or greater than one acre and less than five acres. Small construction activity also includes the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale, if the larger common plan will ultimately disturb equal to or greater than one and less than five acres.
- d) **Qualifying Local Program:** This permit includes conditions that incorporate qualifying local erosion and sediment control program (Qualifying Local Program) requirements by reference. A Qualifying Local Program is a municipal stormwater program for stormwater discharges associated with small construction activity that has been formally approved by the Division.

Other Definitions: Definitions of additional terms can be found in Part I.E. of this permit.

3. **Permit Coverage Without Application – for small construction activities under a Qualifying Local Program only**

If a small construction site is within the jurisdiction of a Qualifying Local Program, the operator of the construction activity is authorized to discharge stormwater associated with small construction activity under this general permit without the submittal of an application to the Division.

- a) **Applicable Sections:** For sites covered by a Qualifying Local Program, only Parts 1.A.1, 1.A.2, 1.A.3, I.D.1, I.D.2, I.D.3, I.D.4, I.D.7, I.D.8, I.D.11, I.E and Part II of this permit, with the exception of Parts II.A.1, II.B.3, II.B.8, and II.B10, apply.

A. COVERAGE UNDER THIS PERMIT (cont.)

- b) **Local Agency Authority:** This permit does not pre-empt or supersede the authority of local agencies to prohibit, restrict, or control discharges of stormwater to storm drain systems or other water courses within their jurisdiction.
- c) **Permit Coverage Termination:** When a site under a Qualifying Local Program has been finally stabilized, coverage under this permit is automatically terminated.
- d) **Compliance with Qualifying Local Program:** A construction site operator that has authorization to discharge under this permit under Part I.A.3 shall comply with the requirements of the Qualifying Local Program with jurisdiction over the site.
- e) **Full Permit Applicability:** The Division may require any operator within the jurisdiction of a Qualifying Local Program covered under this permit to apply for and obtain coverage under the full requirements of this permit. The operator must be notified in writing that an application for full coverage is required. When a permit certification under this permit is issued to an operator that would otherwise be covered under Part I.A.3 of this permit, the full requirements of this permit replace the requirements as per Part I.A.3 of this permit, upon the effective date of the permit certification. A site brought under the full requirements of this permit must still comply with local stormwater management requirements, policies or guidelines as required by Part I.D.1.g of this permit.

4. **Application, Due Dates**

- a) **Application Due Dates:** At least **ten calendar days** prior to the commencement of construction activities, the applicant shall submit an application form as provided by the Division, with a certification that the Stormwater Management Plan (SWMP) is complete.

One original completed discharge permit application shall be submitted, by mail or hand delivery, to:

Colorado Department of Public Health and Environment
Water Quality Control Division
WQCD-Permits-B2
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

- b) **Summary of Application:** The application requires, at a minimum, the following:
 - 1) The applicant's company name; address; telephone number; and email address (if available); whether the applicant is the owner, developer, or contractor; and local contact information;
 - 2) Project name, address, county and location of the construction site, including the latitude and longitude to the nearest 15 seconds of the approximate center of the construction activity;
 - 3) Legal description or map of the construction site;
 - 4) Estimates of: the total area of the site, the area of the site that is expected to be disturbed, and the total area of the larger common plan of development or sale to undergo disturbance;
 - 5) The nature of the construction activity;
 - 6) The anticipated start date and final stabilization date for the project;
 - 7) The name of the receiving water(s), or the municipal separate storm sewer system and the ultimate (i.e., named) receiving water(s);
 - 8) Certification that the SWMP for the construction site is complete (see Part I.C. below); and
 - 9) The signature of the applicant, signed in accordance with Part I.F.1 of this permit.

5. **Permit Certification Procedures**

If this general permit is appropriate for the applicant's operation, then a certification will be developed and the applicant will be authorized to discharge stormwater under this general permit.

- a) **Request for Additional Information:** The Division shall have up to **ten calendar days** after receipt of the above information to request additional data and/or deny the authorization for any particular discharge. Upon receipt of additional information, the Division shall have an additional **ten calendar days** to issue or deny authorization for the particular discharge. (Notification of denial shall be by letter, in cases where coverage under an alternate general permit or an individual permit is required, instead of coverage under this permit.)

A. COVERAGE UNDER THIS PERMIT (cont.)

- b) **Automatic Coverage:** If the applicant does not receive a request for additional information or a notification of denial from the Division dated within ten calendar days of receipt of the application by the Division, authorization to discharge in accordance with the conditions of this permit shall be deemed granted.
- c) **Individual Permit Required:** If, after evaluation of the application (or additional information, such as the SWMP), it is found that this general permit is not appropriate for the operation, then the application will be processed as one for an individual permit. The applicant will be notified of the Division's decision to deny certification under this general permit. For an individual permit, additional information may be requested, and 180 days may be required to process the application and issue the permit. At the Division's discretion, temporary coverage under this general permit may be allowed until the individual permit goes into effect.
- d) **General vs. Individual Permit Coverage:** Any permittee authorized by this permit may request to be excluded from the coverage of this permit by applying for an individual CDPS permit. The permittee shall submit an individual application, with reasons supporting the request, to the Division at least 180 days prior to any discharge.
- e) **Local Agency Authority:** This permit does not pre-empt or supersede the authority of local agencies to prohibit, restrict, or control discharges of stormwater to storm drain systems or other water courses within their jurisdiction.

6. **Inactivation Notice**

When a site has been finally stabilized in accordance with the SWMP, the permittee must submit an **Inactivation Notice** form that is signed in accordance with Part I.F.1. of this permit. The Inactivation Notice form is available from the Division and includes:

- a) Permit certification number;
- b) The permittee's name, address, telephone number;
- c) Name, location, and county for the construction site for which the inactivation notice is being submitted; and
- d) Certification that the site has been finally stabilized, and a description of the final stabilization method(s).

7. **Transfer of Permit**

When responsibility for stormwater discharges at a construction site changes from one entity to another, the permittee shall submit a completed **Notice of Transfer and Acceptance of Terms** form that is signed in accordance with Part I.F.1. of this permit. The Notice of Transfer form is available from the Division and includes:

- a) Permit certification number;
- b) Name, location, and county for the construction site for which the Notice of Transfer is being submitted;
- c) Identifying information for the new permittee;
- d) Identifying information for the current permittee; and
- e) Effective date of transfer.

If the new responsible party will not complete the transfer form, the permit may be inactivated upon written request to the Division and completion of the Inactivation Notice if the permittee has no legal responsibility, through ownership or contract, for the construction activities at the site. In this case, the new owner or operator would be required to obtain permit coverage separately.

8. **Reassignment of Permit**

When a permittee no longer has control of a specific portion of a permitted site, and wishes to transfer coverage of that portion of the site to a second party, the permittee shall submit a completed **Notice of Reassignment of Permit Coverage** form that is signed in accordance with Part I.F.1. of this permit. The Notice of Reassignment of Permit Coverage form is available from the Division and includes:

- a) Current permit certification number;
- b) Identifying information and certification as required by Part I.A.4.b for the new permittee;
- c) Identifying information for the current permittee, revised site information and certification for reassignment; and
- d) Effective date of reassignment.

A. COVERAGE UNDER THIS PERMIT (cont.)

If the new responsible party will not complete the reassignment form, the applicable portion of the permitted site may be removed from permit coverage upon written request to the Division if the permittee has no legal responsibility, through ownership or contract, for the construction activities at the portion of the site. In this case, the new owner or operator would be required to obtain permit coverage separately.

9. **Sale of Residence to Homeowners**

For residential construction only, when a residential lot **has been conveyed to a homeowner** and all criteria in paragraphs a through e, below, are met, coverage under this permit is no longer required and the conveyed lot may be removed from coverage under the permittee's certification. At such time, the permittee is no longer responsible for meeting the terms and conditions of this permit for the conveyed lot, including the requirement to transfer or reassign permit coverage. The permittee remains responsible for inactivation of the original certification.

- a) The lot has been sold to the homeowner(s) for private residential use;
- b) the lot is less than one acre of disturbed area;
- c) all construction activity conducted by the permittee on the lot is completed;
- d) a certificate of occupancy (or equivalent) has been awarded to the home owner; and
- e) the SWMP has been amended to indicate the lot is no longer covered by permit.

Lots not meeting all of the above criteria require continued permit coverage. However, this permit coverage may be transferred (Part I.A.7, above) or reassigned (Part I.A.8, above) to a new owner or operator.

10. **Permit Expiration Date**

Authorization to discharge under this general permit shall expire on June 30, 2012. The Division must evaluate and reissue this general permit at least once every five years and must recertify the permittee's authority to discharge under the general permit at such time. Therefore, a permittee desiring continued coverage under the general permit must reapply by March 31, 2012. The Division will initiate the renewal process; however, it is ultimately the permittee's responsibility to ensure that the renewal is submitted. The Division will determine if the permittee may continue to operate under the terms of the general permit. An individual permit may be required for any facility not reauthorized to discharge under the reissued general permit.

11. **Individual Permit Criteria**

Various criteria can be used in evaluating whether or not an individual (or alternate general) permit is required instead of this general permit. This information may come from the application, SWMP, or additional information as requested by the Division, and includes, but is not limited to, the following:

- a) the quality of the receiving waters (i.e., the presence of downstream drinking water intakes or a high quality fishery, or for preservation of high quality water);
- b) the size of the construction site;
- c) evidence of noncompliance under a previous permit for the operation;
- d) the use of chemicals within the stormwater system; or
- e) discharges of pollutants of concern to waters for which there is an established Total Maximum Daily Load (TMDL).

In addition, an individual permit may be required when the Division has shown or has reason to suspect that the stormwater discharge may contribute to a violation of a water quality standard.

B. STORMWATER MANAGEMENT PLAN (SWMP) – **GENERAL REQUIREMENTS**

- 1. A SWMP shall be developed for each facility covered by this permit. The SWMP shall be prepared in accordance with good engineering, hydrologic and pollution control practices. (The SWMP need not be prepared by a registered engineer.)

B. STORMWATER MANAGEMENT PLAN (SWMP) – **GENERAL REQUIREMENTS** (cont.)

2. The SWMP shall:
 - a) Identify all potential sources of pollution which may reasonably be expected to affect the quality of stormwater discharges associated with construction activity from the facility;
 - b) Describe the practices to be used to reduce the pollutants in stormwater discharges associated with construction activity at the facility; and ensure the practices are selected and described in accordance with good engineering practices, including the installation, implementation and maintenance requirements; and
 - c) Be properly prepared, and updated in accordance with Part I.D.5.c, to ensure compliance with the terms and conditions of this permit.
3. Facilities must implement the provisions of the SWMP as written and updated, from commencement of construction activity until final stabilization is complete, as a condition of this permit. The Division reserves the right to review the SWMP, and to require the permittee to develop and implement additional measures to prevent and control pollution as needed.
4. The SWMP may reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans under section 311 of the CWA, or Best Management Practices (BMPs) Programs otherwise required by a separate CDPS permit, and may incorporate any part of such plans into the SWMP by reference, provided that the relevant sections of such plans are available as part of the SWMP consistent with Part I.D.5.b.
5. For any sites with permit coverage before June 30, 2007, the permittee's SWMP must meet the new SWMP requirements as summarized in Section II.I of the rationale. Any needed changes must be made by **October 1, 2007**.

C. STORMWATER MANAGEMENT PLAN (SWMP) – **CONTENTS**

The SWMP shall include the following items, at a minimum.

1. **Site Description.** The SWMP shall clearly describe the construction activity, to include:
 - a) The nature of the construction activity at the site.
 - b) The proposed sequence for major activities.
 - c) Estimates of the total area of the site, and the area and location expected to be disturbed by clearing, excavation, grading, or other construction activities.
 - d) A summary of any existing data used in the development of the site construction plans or SWMP that describe the soil or existing potential for soil erosion.
 - e) A description of the existing vegetation at the site and an estimate of the percent vegetative ground cover.
 - f) The location and description of all potential pollution sources, including ground surface disturbing activities (see Part I.A.2.b), vehicle fueling, storage of fertilizers or chemicals, etc.
 - g) The location and description of any anticipated allowable sources of non-stormwater discharge at the site, e.g., uncontaminated springs, landscape irrigation return flow, construction dewatering, and concrete washout.
 - h) The name of the receiving water(s) and the size, type and location of any outfall(s). If the stormwater discharge is to a municipal separate storm sewer system, the name of that system, the location of the storm sewer discharge, and the ultimate receiving water(s).
2. **Site Map.** The SWMP shall include a legible site map(s), showing the entire site, identifying:
 - a) construction site boundaries;
 - b) all areas of ground surface disturbance;
 - c) areas of cut and fill;
 - d) areas used for storage of building materials, equipment, soil, or waste;
 - e) locations of dedicated asphalt or concrete batch plants;
 - f) locations of all structural BMPs;
 - g) locations of non-structural BMPs as applicable; and
 - h) locations of springs, streams, wetlands and other surface waters.

C. STORMWATER MANAGEMENT PLAN (SWMP) – CONTENTS (cont.)

3. **Stormwater Management Controls.**

The SWMP must include a description of all stormwater management controls that will be implemented as part of the construction activity to control pollutants in stormwater discharges. The appropriateness and priorities of stormwater management controls in the SWMP shall reflect the potential pollutant sources identified at the facility.

The description of stormwater management controls shall address the following components, at a minimum:

- a) **SWMP Administrator** - The SWMP shall identify a specific individual(s), position or title who is responsible for developing, implementing, maintaining, and revising the SWMP. The activities and responsibilities of the administrator shall address all aspects of the facility's SWMP.
- b) **Identification of Potential Pollutant Sources** - All potential pollutant sources, including materials and activities, at a site must be evaluated for the potential to contribute pollutants to stormwater discharges. The SWMP shall identify and describe those sources determined to have the potential to contribute pollutants to stormwater discharges, and the sources must be controlled through BMP selection and implementation, as required in paragraph (c), below.

At a minimum, each of the following sources and activities shall be evaluated for the potential to contribute pollutants to stormwater discharges, and identified in the SWMP if found to have such potential:

- 1) all disturbed and stored soils;
 - 2) vehicle tracking of sediments;
 - 3) management of contaminated soils;
 - 4) loading and unloading operations;
 - 5) outdoor storage activities (building materials, fertilizers, chemicals, etc.);
 - 6) vehicle and equipment maintenance and fueling;
 - 7) significant dust or particulate generating processes;
 - 8) routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, oils, etc.;
 - 9) on-site waste management practices (waste piles, liquid wastes, dumpsters, etc.);
 - 10) concrete truck/equipment washing, including the concrete truck chute and associated fixtures and equipment;
 - 11) dedicated asphalt and concrete batch plants;
 - 12) non-industrial waste sources such as worker trash and portable toilets; and
 - 13) other areas or procedures where potential spills can occur.
- c) **Best Management Practices (BMPs) for Stormwater Pollution Prevention** - The SWMP shall identify and describe appropriate BMPs, including, but not limited to, those required by paragraphs 1 through 8 below, that will be implemented at the facility to reduce the potential of the sources identified in Part I.C.3.b to contribute pollutants to stormwater discharges. The SWMP shall clearly describe the installation and implementation specifications for each BMP identified in the SWMP to ensure proper implementation, operation and maintenance of the BMP.
 - 1) **Structural Practices for Erosion and Sediment Control**. The SWMP shall clearly describe and locate all structural practices implemented at the site to minimize erosion and sediment transport. Practices may include, but are not limited to: straw bales, wattles/sediment control logs, silt fences, earth dikes, drainage swales, sediment traps, subsurface drains, pipe slope drains, inlet protection, outlet protection, gabions, and temporary or permanent sediment basins.
 - 2) **Non-Structural Practices for Erosion and Sediment Control**. The SWMP shall clearly describe and locate, as applicable, all non-structural practices implemented at the site to minimize erosion and sediment transport. Description must include interim and permanent stabilization practices, and site-specific scheduling for implementation of the practices. The SWMP should include practices to ensure that existing vegetation is preserved where possible. Non-structural practices may include, but are not limited to: temporary vegetation, permanent vegetation, mulching, geotextiles, sod stabilization, slope roughening, vegetative buffer strips, protection of trees, and preservation of mature vegetation.

C. STORMWATER MANAGEMENT PLAN (SWMP) – CONTENTS (cont.)

- 3) Phased BMP Implementation. The SWMP shall clearly describe the relationship between the phases of construction, and the implementation and maintenance of both structural and non-structural stormwater management controls. The SWMP must identify the stormwater management controls to be implemented during the project phases, which can include, but are not limited to, clearing and grubbing; road construction; utility and infrastructure installation; vertical construction; final grading; and final stabilization.
- 4) Materials Handling and Spill Prevention. The SWMP shall clearly describe and locate all practices implemented at the site to minimize impacts from procedures or significant materials (see definitions at Part I.E.) that could contribute pollutants to runoff. Such procedures or significant materials could include: exposed storage of building materials; paints and solvents; fertilizers or chemicals; waste material; and equipment maintenance or fueling procedures.

Areas or procedures where potential spills can occur must have spill prevention and response procedures identified in the SWMP.

- 5) Dedicated Concrete or Asphalt Batch Plants. The SWMP shall clearly describe and locate all practices implemented at the site to control stormwater pollution from dedicated concrete batch plants or dedicated asphalt batch plants covered by this certification.
- 6) Vehicle Tracking Control. The SWMP shall clearly describe and locate all practices implemented at the site to control potential sediment discharges from vehicle tracking. Practices must be implemented for all areas of potential vehicle tracking, and can include: minimizing site access; street sweeping or scraping; tracking pads; graveled parking areas; requiring that vehicles stay on paved areas on-site; wash racks; contractor education; and/or sediment control BMPs, etc.
- 7) Waste Management and Disposal, Including Concrete Washout.
 - i) The SWMP shall clearly describe and locate the practices implemented at the site to control stormwater pollution from all construction site wastes (liquid and solid), including concrete washout activities.
 - ii) The practices used for concrete washout must ensure that these activities do not result in the contribution of pollutants associated with the washing activity to stormwater runoff.
 - iii) Part I.D.3.c of the permit authorizes the conditional discharge of concrete washout water to the ground. The SWMP shall clearly describe and locate the practices to be used that will ensure that no washout water from concrete washout activities is discharged from the site as surface runoff or to surface waters.
- 8) Groundwater and Stormwater Dewatering.
 - i) The SWMP shall clearly describe and locate the practices implemented at the site to control stormwater pollution from the dewatering of groundwater or stormwater from excavations, wells, etc.
 - ii) Part I.D.3.d of the permit authorizes the conditional discharge of construction dewatering to the ground. For any construction dewatering of groundwater not authorized under a separate CDPS discharge permit, the SWMP shall clearly describe and locate the practices to be used that will ensure that no groundwater from construction dewatering is discharged from the site as surface runoff or to surface waters.

4. Final Stabilization and Long-term Stormwater Management

- a) The SWMP shall clearly describe the practices used to achieve final stabilization of all disturbed areas at the site, and any planned practices to control pollutants in stormwater discharges that will occur after construction operations have been completed at the site.
- b) Final stabilization practices for obtaining a vegetative cover should include, as appropriate: seed mix selection and application methods; soil preparation and amendments; soil stabilization practices (e.g., crimped straw, hydro mulch or rolled erosion control products); and appropriate sediment control BMPs as needed until final stabilization is achieved; etc.

C. STORMWATER MANAGEMENT PLAN (SWMP) – CONTENTS (cont.)

- c) Final stabilization is reached when all ground surface disturbing activities at the site have been completed, and uniform vegetative cover has been established with an individual plant density of at least 70 percent of pre-disturbance levels, or equivalent permanent, physical erosion reduction methods have been employed.

The Division may, after consultation with the permittee and upon good cause, amend the final stabilization criteria in this section for specific operations.

5. **Inspection and Maintenance**

Part I.D.6 of the permit includes requirements for site inspections. Part I.D.7 of the permit includes requirements for BMP maintenance. The SWMP shall clearly describe the inspection and maintenance procedures implemented at the site to maintain all erosion and sediment control practices and other protective practices identified in the SWMP, in good and effective operating condition.

D. TERMS AND CONDITIONS

1. **General Limitations**

The following limitations shall apply to all discharges covered by this permit:

- a) Stormwater discharges from construction activities shall not cause, have the reasonable potential to cause, or measurably contribute to an exceedance of any water quality standard, including narrative standards for water quality.
- b) Concrete washout water shall not be discharged to state surface waters or to storm sewer systems. On-site permanent disposal of concrete washout waste is not authorized by this permit. Discharge to the ground of concrete washout waste that will subsequently be disposed of off-site is authorized by this permit. See Part I.D.3.c of the permit.
- c) Bulk storage structures for petroleum products and any other chemicals shall have secondary containment or equivalent adequate protection so as to contain all spills and prevent any spilled material from entering State waters.
- d) No chemicals are to be added to the discharge unless permission for the use of a specific chemical is granted by the Division. In granting the use of such chemicals, special conditions and monitoring may be addressed by separate correspondence.
- e) The Division reserves the right to require sampling and testing, on a case-by-case basis, in the event that there is reason to suspect that compliance with the SWMP is a problem, or to measure the effectiveness of the BMPs in removing pollutants in the effluent. Such monitoring may include Whole Effluent Toxicity testing.
- f) All site wastes must be properly managed to prevent potential pollution of State waters. This permit does not authorize on-site waste disposal.
- g) All dischargers must comply with the lawful requirements of federal agencies, municipalities, counties, drainage districts and other local agencies regarding any discharges of stormwater to storm drain systems or other water courses under their jurisdiction, including applicable requirements in municipal stormwater management programs developed to comply with CDPS permits. Dischargers must comply with local stormwater management requirements, policies or guidelines including erosion and sediment control.

2. **BMP Implementation and Design Standards**

Facilities must select, install, implement, and maintain appropriate BMPs, following good engineering, hydrologic and pollution control practices. BMPs implemented at the site must be adequately designed to provide control for all potential pollutant sources associated with construction activity to prevent pollution or degradation of State waters.

D. TERMS AND CONDITIONS (cont.)

3. **Prohibition of Non-Stormwater Discharges**

- a) Except as provided in paragraphs b, c, and d below, **all discharges covered by this permit shall be composed entirely of stormwater associated with construction activity.** Discharges of material other than stormwater must be addressed in a separate CDPS permit issued for that discharge.
- b) Discharges from the following sources that are combined with stormwater discharges associated with construction activity may be authorized by this permit, provided that the non-stormwater component of the discharge is identified in the SWMP (see Part I.C.1.g of this permit):
 - emergency fire fighting activities
 - landscape irrigation return flow
 - uncontaminated springs
- c) Discharges to the ground of concrete washout water from washing of tools and concrete mixer chutes may be authorized by this permit, provided that:
 - 1) the source is identified in the SWMP;
 - 2) BMPs are included in the SWMP in accordance with Part I.C.3(c)(7) and to prevent pollution of groundwater in violation of Part I.D.1.a; and
 - 3) these discharges do not leave the site as surface runoff or to surface waters
- d) Discharges to the ground of water from construction dewatering activities may be authorized by this permit, provided that:
 - 1) the source is groundwater and/or groundwater combined with stormwater that does not contain pollutants in concentrations exceeding the State groundwater standards in Regulations 5 CCR 1002-41 and 42;
 - 2) the source is identified in the SWMP;
 - 3) BMPs are included in the SWMP, as required by Part I.C.3(c)(8); and
 - 4) these discharges do not leave the site as surface runoff or to surface waters.

Discharges to the ground from construction dewatering activities that do not meet the above criteria must be covered under a separate CDPS discharge permit. Contaminated groundwater requiring coverage under a separate CDPS discharge permit may include groundwater contaminated with pollutants from a landfill, mining activity, industrial pollutant plume, underground storage tank, or other source.

4. **Releases in Excess of Reportable Quantities**

This permit does not relieve the permittee of the reporting requirements of 40 CFR 110, 40 CFR 117 or 40 CFR 302. Any discharge of hazardous material must be handled in accordance with the Division's Noncompliance Notification Requirements (see Part II.A.3 of the permit).

5. **SWMP Requirements**

- a) **SWMP Preparation and Implementation:** The SWMP shall be prepared prior to applying for coverage under the general permit, and certification of its completion submitted with the application. The SWMP shall be implemented prior to commencement of construction activities. The plan shall be updated as appropriate (see paragraph c, below), below). SWMP provisions shall be implemented until expiration or inactivation of permit coverage.
- b) **SWMP Retention Requirements:** A copy of the SWMP must be retained on site unless another location, specified by the permittee, is approved by the Division.
- c) **SWMP Review/Changes:** The permittee shall amend the SWMP:
 - 1) when there is a change in design, construction, operation, or maintenance of the site, which would require the implementation of new or revised BMPs; or
 - 2) if the SWMP proves to be ineffective in achieving the general objectives of controlling pollutants in stormwater discharges associated with construction activity; or

D. TERMS AND CONDITIONS (cont.)

- 3) when BMPs are no longer necessary and are removed.

SWMP changes shall be made prior to changes in the site conditions, except as allowed for in paragraph d, below. SWMP revisions may include, but are not limited to: potential pollutant source identification; selection of appropriate BMPs for site conditions; BMP maintenance procedures; and interim and final stabilization practices. The SWMP changes may include a schedule for further BMP design and implementation, provided that, if any interim BMPs are needed to comply with the permit, they are also included in the SWMP and implemented during the interim period.

- d) **Responsive SWMP Changes:** SWMP changes addressing BMP installation and/or implementation are often required to be made in response to changing conditions, or when current BMPs are determined ineffective. The majority of SWMP revisions to address these changes can be made immediately with quick in-the-field revisions to the SWMP. In the less common scenario where more complex development of materials to modify the SWMP is necessary, SWMP revisions shall be made in accordance with the following requirements:

- 1) the SWMP shall be revised as soon as practicable, but in no case more than 72 hours after the change(s) in BMP installation and/or implementation occur at the site, and
- 2) a notation must be included in the SWMP prior to the site change(s) that includes the time and date of the change(s) in the field, an identification of the BMP(s) removed or added, and the location(s) of those BMP(s).

6. **Inspections**

Site inspections must be conducted in accordance with the following requirements and minimum schedules. The required minimum inspection schedules do not reduce or eliminate the permittee's responsibility to implement and maintain BMPs in good and effective operational condition, and in accordance with the SWMP, which could require more frequent inspections.

- a) **Minimum Inspection Schedule:** The permittee shall, at a minimum, make a thorough inspection, in accordance with the requirements in I.D.6.b below, at least once every 14 calendar days. Also, post-storm event inspections must be conducted within 24 hours after the end of any precipitation or snowmelt event that causes surface erosion. Provided the timing is appropriate, the post-storm inspections may be used to fulfill the 14-day routine inspection requirement. A more frequent inspection schedule than the minimum inspections described may be necessary, to ensure that BMPs continue to operate as needed to comply with the permit. The following conditional modifications to this Minimum Inspection Schedule are allowed:
 - 1) **Post-Storm Event Inspections at Temporarily Idle Sites** – If no construction activities will occur following a storm event, post-storm event inspections shall be conducted prior to re-commencing construction activities, but no later than 72 hours following the storm event. The occurrence of any such delayed inspection must be documented in the inspection record. Routine inspections still must be conducted at least every 14 calendar days.
 - 2) **Inspections at Completed Sites/Areas** – For sites or portions of sites that meet the following criteria, but final stabilization has not been achieved due to a vegetative cover that has not become established, the permittee shall make a thorough inspection of their stormwater management system at least once every month, and post-storm event inspections are not required. This reduced inspection schedule is *only* allowed if:
 - i) all construction activities that will result in surface ground disturbance are completed;
 - ii) all activities required for final stabilization, in accordance with the SWMP, have been completed, with the exception of the application of seed that has not occurred due to seasonal conditions or the necessity for additional seed application to augment previous efforts; and
 - iii) the SWMP has been amended to indicate those areas that will be inspected in accordance with the reduced schedule allowed for in this paragraph.

D. TERMS AND CONDITIONS (cont.)

- 3) **Winter Conditions Inspections Exclusion** – Inspections are not required at sites where construction activities are temporarily halted, snow cover exists over the entire site for an extended period, and melting conditions posing a risk of surface erosion do not exist. This exception is applicable only during the period where melting conditions do not exist, and applies to the routine 14-day and monthly inspections, as well as the post-storm-event inspections. The following information must be documented in the inspection record for use of this exclusion: dates when snow cover occurred, date when construction activities ceased, and date melting conditions began. Inspections, as described above, are required at all other times.

When site conditions make the schedule required in this section impractical, the permittee may petition the Division to grant an alternate inspection schedule.

b) **Inspection Requirements**

- 1) **Inspection Scope** - The construction site perimeter, all disturbed areas, material and/or waste storage areas that are exposed to precipitation, discharge locations, and locations where vehicles access the site shall be inspected for evidence of, or the potential for, pollutants leaving the construction site boundaries, entering the stormwater drainage system, or discharging to state waters. All erosion and sediment control practices identified in the SWMP shall be evaluated to ensure that they are maintained and operating correctly.
- 2) **Inspection Report/Records** - The permittee shall keep a record of inspections. Inspection reports must identify any incidents of non-compliance with the terms and conditions of this permit. Inspection records must be retained for three years from expiration or inactivation of permit coverage. At a minimum, the inspection report must include:
- i) The inspection date;
 - ii) Name(s) and title(s) of personnel making the inspection;
 - iii) Location(s) of discharges of sediment or other pollutants from the site;
 - iv) Location(s) of BMPs that need to be maintained;
 - v) Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location;
 - vi) Location(s) where additional BMPs are needed that were not in place at the time of inspection;
 - vii) Deviations from the minimum inspection schedule as provided in Part I.D.6.a above;
 - viii) Description of corrective action for items iii, iv, v, and vi, above, dates corrective action(s) taken, and measures taken to prevent future violations, including requisite changes to the SWMP, as necessary; and
 - viii) After adequate corrective action(s) has been taken, or where a report does not identify any incidents requiring corrective action, the report shall contain a signed statement indicating the site is in compliance with the permit to the best of the signer's knowledge and belief.
- c) **Required Actions Following Site Inspections** – Where site inspections note the need for BMP maintenance activities, BMPs must be maintained in accordance with the SWMP and Part I.D.7 of the permit. Repair, replacement, or installation of new BMPs determined necessary during site inspections to address ineffective or inadequate BMPs must be conducted in accordance with Part I.D.8 of the permit. SWMP updates required as a result of deficiencies in the SWMP noted during site inspections shall be made in accordance with Part I.D.5.c of the permit.

7. **BMP Maintenance**

All erosion and sediment control practices and other protective measures identified in the SWMP must be maintained in effective operating condition. Proper selection and installation of BMPs and implementation of comprehensive Inspection and Maintenance procedures, in accordance with the SWMP, should be adequate to meet this condition. BMPs that are not adequately maintained in accordance with good engineering, hydrologic and pollution control practices, including removal of collected sediment outside the acceptable tolerances of the BMPs, are considered to be no longer operating effectively and must be addressed in accordance with Part I.D.8, below. A specific timeline for implementing maintenance procedures is not included in this permit because BMP maintenance is expected to be proactive, not responsive. Observations resulting in BMP maintenance activities can be made during a site inspection, or during general observations of site conditions.

D. TERMS AND CONDITIONS (cont.)

8. **Replacement and Failed BMPs**

Adequate site assessment must be performed as part of comprehensive Inspection and Maintenance procedures, to assess the adequacy of BMPs at the site, and the necessity of changes to those BMPs to ensure continued effective performance. Where site assessment results in the determination that new or replacement BMPs are necessary, the BMPs must be installed to ensure on-going implementation of BMPs as per Part I.D.2.

Where BMPs have failed, resulting in noncompliance with Part I.D.2, they must be addressed as soon as possible, immediately in most cases, to minimize the discharge of pollutants.

When new BMPs are installed or BMPs are replaced, the SWMP must be updated in accordance with Part I.D.5(c).

9. **Reporting**

No scheduled reporting requirements are included in this permit; however, the Division reserves the right to request that a copy of the inspection reports be submitted.

10. **SWMP Availability**

A copy of the SWMP shall be provided upon request to the Division, EPA, or any local agency in charge of approving sediment and erosion plans, grading plans or stormwater management plans, and within the time frame specified in the request. If the SWMP is required to be submitted to any of these entities, it must include a signed certification in accordance with Part I.F.1 of the permit, certifying that the SWMP is complete and meets all permit requirements.

All SWMPs required under this permit are considered reports that shall be available to the public under Section 308(b) of the CWA and Section 61.5(4) of the Colorado Discharge Permit System Regulations. The permittee shall make plans available to members of the public upon request. However, the permittee may claim any portion of a SWMP as confidential in accordance with 40 CFR Part 2.

11. **Total Maximum Daily Load (TMDL)**

If a TMDL has been approved for any waterbody into which the permittee discharges, and stormwater discharges associated with construction activity have been assigned a pollutant-specific Wasteload Allocation (WLA) under the TMDL, the Division will either:

- a) Ensure that the WLA is being implemented properly through alternative local requirements, such as by a municipal stormwater permit; or
- b) Notify the permittee of the WLA, and amend the permittee's certification to add specific BMPs and/or other requirements, as appropriate. The permittee may be required to do the following:
 - 1) Under the permittee's SWMP, implement specific management practices based on requirements of the WLA, and evaluate whether the requirements are being met through implementation of existing stormwater BMPs or if additional BMPs are necessary. Document the calculations or other evidence that show that the requirements are expected to be met; and
 - 2) If the evaluation shows that additional or modified BMPs are necessary, describe the type and schedule for the BMP additions/revisions.

Discharge monitoring may also be required. The permittee may maintain coverage under the general permit provided they comply with the applicable requirements outlined above. The Division reserves the right to require individual or alternate general permit coverage.

E. ADDITIONAL DEFINITIONS

For the purposes of this permit:

1. **Best Management Practices (BMPs):** schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, pollution prevention, and practices to control site runoff, spillage or leaks, waste disposal, or drainage from material storage.
2. **Dedicated asphalt plants and concrete plants:** portable asphalt plants and concrete plants that are located on or adjacent to a construction site and that provide materials only to that specific construction site.
3. **Final stabilization:** when all ground surface disturbing activities at the site have been completed, and uniform vegetative cover has been established with an individual plant density of at least 70 percent of pre-disturbance levels, or equivalent permanent, physical erosion reduction methods have been employed. For purposes of this permit, establishment of a vegetative cover capable of providing erosion control equivalent to pre-existing conditions at the site will be considered final stabilization.
4. **Municipal separate storm sewer system:** a conveyance or system of conveyances (including: roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains), owned or operated by a State, city, town, county, district, or other public body (created by state law), having jurisdiction over disposal of sewage, industrial waste, stormwater, or other wastes; designed or used for collecting or conveying stormwater.
5. **Operator:** the entity that has day-to-day supervision and control of activities occurring at the construction site. This can be the owner, the developer, the general contractor or the agent of one of these parties, in some circumstances. It is anticipated that at different phases of a construction project, different types of parties may satisfy the definition of 'operator' and that the permit may be transferred as the roles change.
6. **Outfall:** a point source at the point where stormwater leaves the construction site and discharges to a receiving water or a stormwater collection system.
7. **Part of a larger common plan of development or sale:** a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules.
8. **Point source:** any discernible, confined and discrete conveyance from which pollutants are or may be discharged. Point source discharges of stormwater result from structures which increase the imperviousness of the ground which acts to collect runoff, with runoff being conveyed along the resulting drainage or grading pattern.
9. **Pollutant:** dredged spoil, dirt, slurry, solid waste, incinerator residue, sewage, sewage sludge, garbage, trash, chemical waste, biological nutrient, biological material, radioactive material, heat, wrecked or discarded equipment, rock, sand, or any industrial, municipal or agricultural waste.
10. **Process water:** any water which, during manufacturing or processing, comes into contact with or results from the production of any raw material, intermediate product, finished product, by product or waste product. This definition includes mine drainage.
11. **Receiving Water:** any classified stream segment (including tributaries) in the State of Colorado into which stormwater related to construction activities discharges. This definition includes all water courses, even if they are usually dry, such as borrow ditches, arroyos, and other unnamed waterways.
12. **Significant Materials** include, but are not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA; any chemical the facility is required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with stormwater discharge.
13. **Stormwater:** precipitation-induced surface runoff.

F. GENERAL REQUIREMENTS

1. **Signatory Requirements**

- a) All reports required for submittal shall be signed and certified for accuracy by the permittee in accordance with the following criteria:
 - 1) In the case of corporations, by a principal executive officer of at least the level of vice-president or his or her duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge described in the form originates;
 - 2) In the case of a partnership, by a general partner;
 - 3) In the case of a sole proprietorship, by the proprietor;
 - 4) In the case of a municipal, state, or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee, if such representative is responsible for the overall operation of the facility from which the discharge described in the form originates.
- b) **Changes to authorization.** If an authorization under paragraph a) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph a) of this section must be submitted to the Division, prior to or together with any reports, information, or applications to be signed by an authorized representative.
- c) **Certification.** Any person signing a document under paragraph a) of this section shall make the following certification:

“I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

2. **Retention of Records**

- a) The permittee shall retain copies of the SWMP and all reports required by this permit and records of all data used to complete the application to be covered by this permit, for three years after expiration or inactivation of permit coverage.
- b) The permittee shall retain a copy of the SWMP required by this permit at the construction site from the date of project initiation to the date of expiration or inactivation of permit coverage, unless another location, specified by the permittee, is approved by the Division.

3. **Monitoring**

The Division reserves the right to require sampling and testing, on a case-by-case basis (see Part I.D.1.e), for example to implement the provisions of a TMDL (see Part I.D.11 of the permit). Reporting procedures for any monitoring data collected will be included in the notification by the Division of monitoring requirements.

If monitoring is required, the following definitions apply:

- a) The **thirty (30) day average** shall be determined by the arithmetic mean of all samples collected during a thirty (30) consecutive-day period.
- b) A **grab** sample, for monitoring requirements, is a single “dip and take” sample.

PART II

A. MANAGEMENT REQUIREMENTS

1. **Amending a Permit Certification**

The permittee shall inform the Division (Permits Section) in writing of changes to the information provided in the permit application, including the legal contact, the project legal description or map originally submitted with the application, or the planned total disturbed acreage. The permittee shall furnish the Division with any plans and specifications which the Division deems reasonably necessary to evaluate the effect on the discharge and receiving stream. If applicable, this notification may be accomplished through submittal of an application for a CDPS process water permit authorizing the discharge. The SWMP shall be updated and implemented prior to the changes (see Part I.D.5.c).

Any discharge to the waters of the State from a point source other than specifically authorized by this permit or a different CDPS permit is prohibited.

2. **Special Notifications - Definitions**

- a) **Spill:** An unintentional release of solid or liquid material which may cause pollution of state waters.
- b) **Upset:** An exceptional incident in which there is unintentional and temporary noncompliance with permit discharge limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

3. **Noncompliance Notification**

- a) The permittee shall report the following instances of noncompliance:
 - 1) Any noncompliance which may endanger health or the environment;
 - 2) Any spill or discharge of hazardous substances or oil which may cause pollution of the waters of the state.
 - 3) Any discharge of stormwater which may cause an exceedance of a water quality standard.
- b) For all instances of noncompliance based on environmental hazards and chemical spills and releases, all needed information must be provided orally to the Colorado Department of Public Health and Environment spill reporting line (24-hour number for environmental hazards and chemical spills and releases: 1-877-518-5608) within 24 hours from the time the permittee becomes aware of the circumstances.

For all other instances of noncompliance as defined in this section, all needed information must be provided orally to the Water Quality Control Division within 24 hours from the time the permittee becomes aware of the circumstances.

For all instances of noncompliance identified here, a written submission shall also be provided within 5 calendar days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of:

- 1) The noncompliance and its cause;
- 2) The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue;
- 3) Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

A. MANAGEMENT REQUIREMENTS (cont.)

4. **Submission of Incorrect or Incomplete Information**

Where the permittee failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or report to the Division, or relevant new information becomes available, the permittee shall promptly submit the relevant application information which was not submitted or any additional information needed to correct any erroneous information previously submitted.

5. **Bypass**

a) A bypass, which causes effluent limitations (i.e., requirements to implement BMPs in accordance with Parts I.B.3 and I.D.2 of the permit) to be exceeded is prohibited, and the Division may take enforcement action against a permittee for such a bypass, unless:

- 1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- 2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities (e.g., alternative BMPs), retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment (e.g., implemented additional BMPs) to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and
- 3) The permittee submitted notices as required in "Non-Compliance Notification," Part II.A.3.

6. **Upsets**

a) **Effect of an Upset:** An upset constitutes an affirmative defense to an action brought for noncompliance with permit limitations and requirements if the requirements of paragraph b of this section are met. (No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.)

b) **Conditions Necessary for a Demonstration of Upset:** A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed contemporaneous operating logs, or other relevant evidence that:

- 1) An upset occurred and that the permittee can identify the specific cause(s) of the upset;
- 2) The permitted facility was at the time being properly operated;
- 3) The permittee submitted notice of the upset as required in Part II.A.3. of this permit (24-hour notice); and
- 4) The permittee complied with any remedial measures required under 40 CFR Section 122.41(d) of the federal regulations or Section 61.8(3)(h) of the Colorado Discharge Permit System Regulations.

c) **Burden of Proof:** In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

7. **Removed Substances**

Solids, sludges, or other pollutants removed in the course of treatment or control of discharges shall be properly disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the State.

8. **Minimization of Adverse Impact**

The permittee shall take all reasonable steps to minimize any adverse impact to waters of the State resulting from noncompliance with any terms and conditions specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

A. MANAGEMENT REQUIREMENTS (cont.)

9. **Reduction, Loss, or Failure of Stormwater Controls**

The permittee has the duty to halt or reduce any activity if necessary to maintain compliance with the permit requirements. Upon reduction, loss, or failure of any stormwater controls, the permittee shall, to the extent necessary to maintain compliance with its permit, control production, or remove all pollutant sources from exposure to stormwater, or both, until the stormwater controls are restored or an alternative method of treatment/control is provided.

It shall not be a defense for a permittee in an enforcement action that it would be necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

10. **Proper Operation and Maintenance**

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

B. RESPONSIBILITIES

1. **Inspections and Right to Entry**

The permittee shall allow the Director of the State Water Quality Control Division, the EPA Regional Administrator, and/or their authorized representative(s), upon the presentation of credentials:

- a) To enter upon the permittee's premises where a regulated facility or activity is located or in which any records are required to be kept under the terms and conditions of this permit;
- b) At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit and to inspect any monitoring equipment or monitoring method required in the permit; and
- c) To enter upon the permittee's premises to investigate, within reason, any actual, suspected, or potential source of water pollution, or any violation of the Colorado Water Quality Control Act. The investigation may include, but is not limited to, the following: sampling of any discharge and/or process waters, the taking of photographs, interviewing permittee staff on alleged violations and other matters related to the permit, and access to any and all facilities or areas within the permittee's premises that may have any effect on the discharge, permit, or any alleged violation.

2. **Duty to Provide Information**

The permittee shall furnish to the Division, within the time frame specified by the Division, any information which the Division may request to determine whether cause exists for modifying, revoking and reissuing, or inactivating coverage under this permit, or to determine compliance with this permit. The permittee shall also furnish to the Division, upon request, copies of records required to be kept by this permit.

3. **Transfer of Ownership or Control**

Certification under this permit may be transferred to a new permittee if:

- a) The current permittee notifies the Division in writing when the transfer is desired as outlined in Part I.A.7; and
- b) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage and liability between them; and
- c) The current permittee has met all fee requirements of the Colorado Discharge Permit System Regulations, Section 61.15.

B. RESPONSIBILITIES (cont.)

4. **Modification, Suspension, or Revocation of Permit By Division**

All permit modification, inactivation or revocation and reissuance actions shall be subject to the requirements of the Colorado Discharge Permit System Regulations, Sections 61.5(2), 61.5(3), 61.7 and 61.15, 5 C.C.R. 1002-61, except for minor modifications.

- a) This permit, and/or certification under this permit, may be modified, suspended, or revoked in whole or in part during its term for reasons determined by the Division including, but not limited to, the following:
 - 1) Violation of any terms or conditions of the permit;
 - 2) Obtaining a permit by misrepresentation or failing to disclose any fact which is material to the granting or denial of a permit or to the establishment of terms or conditions of the permit;
 - 3) Materially false or inaccurate statements or information in the application for the permit;
 - 4) Promulgation of toxic effluent standards or prohibitions (including any schedule of compliance specified in such effluent standard or prohibition) which are established under Section 307 of the Clean Water Act, where such a toxic pollutant is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit.
- b) This permit, and/or certification under this permit, may be modified in whole or in part due to a change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge, such as:
 - 1) Promulgation of Water Quality Standards applicable to waters affected by the permitted discharge; or
 - 2) Effluent limitations or other requirements applicable pursuant to the State Act or federal requirements; or
 - 3) Control regulations promulgated; or
 - 4) Other available information indicates a potential for violation of adopted Water Quality Standards or stream classifications.
- c) This permit, or certification under this permit, may be modified in whole or in part to include new effluent limitations and other appropriate permit conditions where data submitted pursuant to Part I indicate that such effluent limitations and permit conditions are necessary to ensure compliance with applicable water quality standards and protection of classified uses.
- d) At the request of the permittee, the Division may modify or inactivate certification under this permit if the following conditions are met:
 - 1) In the case of inactivation, the permittee notifies the Division of its intent to inactivate the certification, and certifies that the site has been finally stabilized;
 - 2) In the case of inactivation, the permittee has ceased any and all discharges to state waters and demonstrates to the Division there is no probability of further uncontrolled discharge(s) which may affect waters of the State.
 - 3) The Division finds that the permittee has shown reasonable grounds consistent with the Federal and State statutes and regulations for such modification, amendment or inactivation;
 - 4) Fee requirements of Section 61.15 of the Colorado Discharge Permit System Regulations have been met; and
 - 5) Applicable requirements of public notice have been met.

For small construction sites covered by a Qualifying Local Program, coverage under this permit is automatically terminated when a site has been finally stabilized.

B. RESPONSIBILITIES (cont.)

5. **Permit Violations**

Failure to comply with any terms and/or conditions of this permit shall be a violation of this permit.

Dischargers of stormwater associated with industrial activity, as defined in the EPA Stormwater Regulation (40 CFR 122.26(b)(14) and Section 61.3(2) of the Colorado Discharge Permit System Regulations, which do not obtain coverage under this or other Colorado general permits, or under an individual CDPS permit regulating industrial stormwater, will be in violation of the federal Clean Water Act and the Colorado Water Quality Control Act, 25-8-101, as amended. Failure to comply with CDPS permit requirements will also constitute a violation.

6. **Legal Responsibilities**

The issuance of this permit does not convey any property or water rights in either real or personal property, or stream flows, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority granted by Section 510 of the Clean Water Act.

7. **Severability**

The provisions of this permit are severable. If any provisions of this permit, or the application of any provision of this permit to any circumstance, are held invalid, the application of such provision to other circumstances and the application of the remainder of this permit shall not be affected.

8. **Renewal Application**

If the permittee desires to continue to discharge, a permit renewal application shall be submitted at least ninety (90) days before this permit expires. If the permittee anticipates that there will be no discharge after the expiration date of this permit, the Division should be promptly notified so that it can inactivate the certification in accordance with Part II.B.4.d.

9. **Confidentiality**

Except for data determined to be confidential under Section 308 of the Federal Clean Water Act and Colorado Discharge Permit System Regulations, Section 61.5(4), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Division. The permittee must state what is confidential at the time of submittal.

Any information relating to any secret process, method of manufacture or production, or sales or marketing data which has been declared confidential by the permittee, and which may be acquired, ascertained, or discovered, whether in any sampling investigation, emergency investigation, or otherwise, shall not be publicly disclosed by any member, officer, or employee of the Commission or the Division, but shall be kept confidential. Any person seeking to invoke the protection of this section shall bear the burden of proving its applicability. This section shall never be interpreted as preventing full disclosure of effluent data.

10. **Fees**

The permittee is required to submit payment of an annual fee as set forth in the Water Quality Control Act. Failure to submit the required fee when due and payable is a violation of the permit and will result in enforcement action pursuant to Section 25-8-601 et. seq., C.R.S. 1973 as amended.

B. RESPONSIBILITIES (cont.)

11. **Requiring an Individual CDPS Permit**

The Director may require the permittee to apply for and obtain an individual or alternate general CDPS permit if:

- a) The discharger is not in compliance with the conditions of this general permit;
- b) Conditions or standards have changed so that the discharge no longer qualifies for a general permit; or
- c) Data/information become available which indicate water quality standards may be violated.

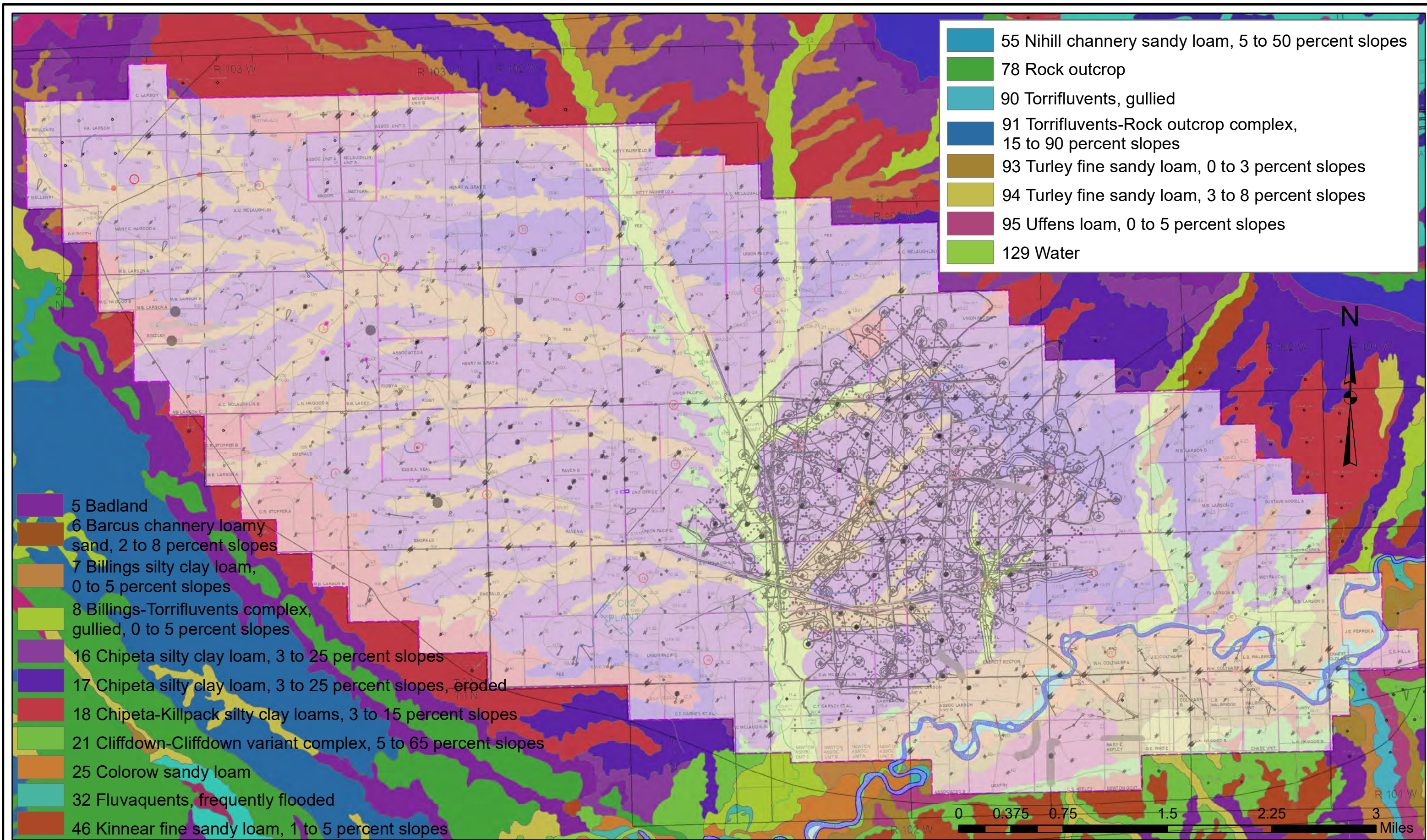
The permittee must be notified in writing that an application for an individual or alternate general CDPS permit is required. When an individual or alternate general CDPS permit is issued to an operator otherwise covered under this general permit, the applicability of this general permit to that operator is automatically inactivated upon the effective date of the individual or alternate general CDPS permit.

Appendix B

NRCS Soil Unit Map

Soil Descriptions

Ecological Site Maps & Descriptions



PROJECT: 009-0944
DRAWN BY: SBS
DATE: March 9, 2012

NRCS Soil Unit Map
Chevron Rangely Weber Sand Unit
Rio Blanco County, Colorado

Rio Blanco County Area, Colorado

5—Badland

Map Unit Setting

Elevation: 5,200 to 7,300 feet

Mean annual precipitation: 8 to 18 inches

Mean annual air temperature: 40 to 50 degrees F

Frost-free period: 75 to 130 days

Map Unit Composition

Badland: 95 percent

Minor components: 5 percent

Description of Badland

Setting

Landform: Canyons, ridges, hills, mountainsides

Down-slope shape: Concave, linear

Across-slope shape: Concave, linear

Parent material: Highly calcareous & gypsiferous residuum
weathered from shale

Properties and qualities

Slope: 10 to 99 percent

Depth to restrictive feature: 0 to 6 inches to paralithic bedrock

Capacity of the most limiting layer to transmit water (Ksat): Very low
to moderately low (0.00 to 0.06 in/hr)

Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability (nonirrigated): 8e

Typical profile

0 to 60 inches: Weathered bedrock

Minor Components

Other soils

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

6—Barcus channery loamy sand, 2 to 8 percent slopes

Map Unit Setting

Elevation: 5,800 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 42 to 44 degrees F
Frost-free period: 80 to 105 days

Map Unit Composition

Barcus and similar soils: 85 percent
Minor components: 15 percent

Description of Barcus

Setting

Landform: Valleys, alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Calcareous alluvium derived from sandstone and shale

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 6e
Ecological site: Foothill Swale (R048AY285CO)

Typical profile

0 to 6 inches: Channery loamy sand
6 to 16 inches: Channery sand
16 to 60 inches: Stratified very channery sand to very channery loamy fine sand

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

7—Billings silty clay loam, 0 to 5 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,800 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 105 to 135 days

Map Unit Composition

Billings and similar soils: 85 percent
Minor components: 15 percent

Description of Billings

Setting

Landform: Terraces, valley floors
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty alluvium derived from shale

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water
(Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: Very high (about 19.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7s

Typical profile

0 to 6 inches: Silty clay loam
6 to 60 inches: Silty clay loam, clay loam

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

8—Billings-Torrifluvents complex, gullied, 0 to 5 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,600 feet
Mean annual precipitation: 7 to 9 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 105 to 135 days

Map Unit Composition

Billings, gullied, and similar soils: 55 percent
Torrifluvents, gullied, and similar soils: 35 percent
Minor components: 10 percent

Description of Billings, Gullied

Setting

Landform: Valley floors, stream terraces, flood plains
Landform position (three-dimensional): Talf, rise, dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous, mixed alluvium derived from shale

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water capacity: Very high (about 20.0 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 2 inches: Silty clay loam
2 to 60 inches: Silty clay loam, clay loam

Description of Torrifluvents, Gullied

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip, rise, talf
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Calcareous, mixed alluvium derived from shale

Properties and qualities

Slope: 0 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately high to high (0.20 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: Occasional

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Gypsum, maximum content: 2 percent

Maximum salinity: Very slightly saline to slightly saline (4.0 to 8.0 mmhos/cm)

Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 5 inches: Loam

5 to 60 inches: Stratified sandy loam to silty clay loam

Minor Components

Other soils

Percent of map unit: 10 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

16—Chipeta silty clay loam, 3 to 25 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,800 feet
Mean annual precipitation: 7 to 9 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 105 to 135 days

Map Unit Composition

Chipeta and similar soils: 85 percent
Minor components: 15 percent

Description of Chipeta

Setting

Landform: Toes, hills
Landform position (three-dimensional): Side slope, base slope, nose slope, head slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gypsiferous residuum weathered from calcareous shale

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 5 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water capacity: Moderate (about 6.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Clayey Saltdesert (R034XY403CO)

Typical profile

0 to 3 inches: Silty clay loam
3 to 18 inches: Silty clay loam, silty clay, clay
18 to 22 inches: Weathered bedrock

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

17—Chipeta silty clay loam, 3 to 25 percent slopes, eroded

Map Unit Setting

Elevation: 5,100 to 5,800 feet
Mean annual precipitation: 7 to 9 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 105 to 135 days

Map Unit Composition

Chipeta and similar soils: 85 percent
Minor components: 15 percent

Description of Chipeta

Setting

Landform: Toes, hills
Landform position (three-dimensional): Head slope, nose slope, base slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gypsiferous residuum weathered from calcareous shale

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 5 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Clayey Saltdesert (R034XY403CO)

Typical profile

0 to 2 inches: Silty clay loam
2 to 12 inches: Silty clay loam, silty clay, clay
12 to 16 inches: Weathered bedrock

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

18—Chipeta-Killpack silty clay loams, 3 to 15 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,800 feet

Mean annual precipitation: 7 to 9 inches

Mean annual air temperature: 47 to 49 degrees F

Frost-free period: 105 to 135 days

Map Unit Composition

Chipeta and similar soils: 60 percent

Killpack and similar soils: 30 percent

Minor components: 10 percent

Description of Chipeta

Setting

Landform: Valley sides, toes, ridges, hills

Landform position (three-dimensional): Head slope, nose slope, base slope, side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Gypsiferous residuum weathered from calcareous shale

Properties and qualities

Slope: 3 to 15 percent

Depth to restrictive feature: 5 to 20 inches to paralithic bedrock

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low
(0.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Gypsum, maximum content: 10 percent

Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)

Sodium adsorption ratio, maximum: 15.0

Available water capacity: Moderate (about 6.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Ecological site: Clayey Saltdesert (R034XY403CO)

Typical profile

0 to 3 inches: Silty clay loam

3 to 18 inches: Silty clay loam, silty clay, clay

18 to 22 inches: Weathered bedrock

Description of Killpack

Setting

Landform: Hills

Landform position (three-dimensional): Nose slope, head slope, base slope, side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Gypsiferous residuum weathered from calcareous shale

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 20 to 40 inches to paralithic bedrock

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Gypsum, maximum content: 1 percent

Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)

Available water capacity: High (about 9.5 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 4 inches: Silty clay loam

4 to 30 inches: Silty clay loam, clay loam

30 to 34 inches: Weathered bedrock

Minor Components

Other soils

Percent of map unit: 10 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

21—Cliffdown-Cliffdown variant complex, 5 to 65 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,800 feet
Mean annual precipitation: 7 to 9 inches
Mean annual air temperature: 47 to 49 degrees F
Frost-free period: 105 to 135 days

Map Unit Composition

Cliffdown and similar soils: 55 percent
Cliffdown variant and similar soils: 35 percent
Minor components: 10 percent

Description of Cliffdown

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous alluvium

Properties and qualities

Slope: 5 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 8.0 mmhos/cm)
Available water capacity: Low (about 4.4 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Saltdesert Breaks (R034XY406CO)

Typical profile

0 to 5 inches: Gravelly loam
5 to 60 inches: Stratified gravelly fine sandy loam to very gravelly loamy sand

Description of Cliffdown Variant

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Calcareous alluvium

Properties and qualities

Slope: 8 to 65 percent

Depth to restrictive feature: 20 to 40 inches to paralithic bedrock

Drainage class: Well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Gypsum, maximum content: 1 percent

Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)

Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 7 inches: Very cobbly loam

7 to 13 inches: Very gravelly loam

13 to 24 inches: Gravelly clay loam

24 to 28 inches: Weathered bedrock

Minor Components

Other soils

Percent of map unit: 10 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

25—Colorow sandy loam

Map Unit Setting

Elevation: 5,050 to 5,800 feet

Mean annual precipitation: 8 to 10 inches

Mean annual air temperature: 47 to 50 degrees F

Frost-free period: 105 to 130 days

Map Unit Composition

Colorow and similar soils: 85 percent

Minor components: 15 percent

Description of Colorow

Setting

Landform: Stream terraces, flood plains, valley floors

Landform position (three-dimensional): Dip, talf, rise

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium derived from sandstone

Properties and qualities

Slope: 0 to 4 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: About 48 to 72 inches

Frequency of flooding: Rare

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)

Available water capacity: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability (nonirrigated): 6c

Ecological site: Sandy Saltdesert (R034XY402CO)

Typical profile

0 to 5 inches: Sandy loam

5 to 32 inches: Stratified loam to fine sandy loam

32 to 43 inches: Stratified fine sandy loam to loamy fine sand

43 to 60 inches: Stratified sandy loam to sand

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

32—Fluvaquents, frequently flooded

Map Unit Setting

Elevation: 5,100 to 7,400 feet
Mean annual precipitation: 8 to 20 inches
Mean annual air temperature: 38 to 50 degrees F
Frost-free period: 45 to 120 days

Map Unit Composition

Fluvaquents, frequently flooded, and similar soils: 85 percent
Minor components: 15 percent

Description of Fluvaquents, Frequently Flooded

Setting

Landform: Flood plains, channels, swales, oxbows, valley floors
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed, basaltic alluvium derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 6 to 48 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 8.0 mmhos/cm)
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability (nonirrigated): 6w
Other vegetative classification: RIVER BOTTOM (048AY236CO)

Typical profile

0 to 10 inches: Stratified sand to clay loam
10 to 60 inches: Stratified very gravelly sand to clay loam

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

46—Kinnear fine sandy loam, 1 to 5 percent slopes

Map Unit Setting

Elevation: 5,200 to 5,800 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 105 to 130 days

Map Unit Composition

Kinnear and similar soils: 85 percent
Minor components: 15 percent

Description of Kinnear

Setting

Landform: Terraces, fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous alluvium and/or eolian deposits

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water
(Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 4.0 mmhos/
cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very high (about 17.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 4c
Ecological site: Loamy Saltdesert (R034XY401CO)

Typical profile

0 to 5 inches: Fine sandy loam
5 to 60 inches: Sandy clay loam, loam

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

55—Nihill channery sandy loam, 5 to 50 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,800 feet

Mean annual precipitation: 10 to 12 inches

Mean annual air temperature: 47 to 49 degrees F

Frost-free period: 105 to 130 days

Map Unit Composition

Nihill and similar soils: 90 percent

Minor components: 10 percent

Description of Nihill

Setting

Landform: Terraces, toes

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Colluvium derived from sandstone

Properties and qualities

Slope: 5 to 50 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)

Sodium adsorption ratio, maximum: 5.0

Available water capacity: Very high (about 13.6 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Ecological site: Salt-desert Breaks (R034XY406CO)

Typical profile

0 to 5 inches: Channery sandy loam

5 to 60 inches: Very channery loam, very channery sandy loam, very gravelly sandy clay loam

Minor Components

Other soils

Percent of map unit: 10 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

78—Rock outcrop

Map Unit Setting

Elevation: 5,100 to 9,600 feet

Mean annual precipitation: 8 to 20 inches

Mean annual air temperature: 38 to 50 degrees F

Frost-free period: 45 to 130 days

Map Unit Composition

Rock outcrop: 90 percent

Minor components: 10 percent

Description of Rock Outcrop

Setting

Landform: Breaks, hills, ridges, canyons, mountains

Down-slope shape: Concave, linear

Across-slope shape: Concave, linear

Parent material: Siltstone and/or limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 99 percent

Depth to restrictive feature: 0 to 4 inches to lithic bedrock

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)

Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability (nonirrigated): 8s

Typical profile

0 to 60 inches: Unweathered bedrock

Minor Components

Other soils

Percent of map unit: 10 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

90—Torrifluvents, gullied

Map Unit Setting

Elevation: 5,100 to 7,000 feet

Mean annual precipitation: 8 to 16 inches

Mean annual air temperature: 40 to 45 degrees F

Frost-free period: 75 to 130 days

Map Unit Composition

Torrifluvents, gullied, and similar soils: 90 percent

Minor components: 10 percent

Description of Torrifluvents, Gullied

Setting

Landform: Eroded fan remnants, swales, valley floors

Landform position (three-dimensional): Rise, dip

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Highly calcareous & gypsiferous, stratified, loamy & clayey sandy alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately high to high (0.20 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: Occasional

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Gypsum, maximum content: 2 percent

Maximum salinity: Very slightly saline to slightly saline (4.0 to 8.0 mmhos/cm)

Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 5 inches: Loam

5 to 60 inches: Stratified sandy loam to silty clay loam

Minor Components

Other soils

Percent of map unit: 10 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

91—Torriorthents-Rock outcrop complex, 15 to 90 percent slopes

Map Unit Setting

Elevation: 5,100 to 7,500 feet
Mean annual precipitation: 8 to 18 inches
Mean annual air temperature: 40 to 50 degrees F
Frost-free period: 70 to 130 days

Map Unit Composition

Torriorthents and similar soils: 50 percent
Rock outcrop: 30 percent
Minor components: 20 percent

Description of Torriorthents

Setting

Landform: Canyons, ridges, hills, mountains
Landform position (three-dimensional): Base slope, side slope, nose slope, head slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Colluvium derived from siltstone and/or residuum weathered from limestone, sandstone, and shale

Properties and qualities

Slope: 15 to 65 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.3 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Stony Foothills (R048AY287CO)

Typical profile

0 to 3 inches: Channery loam
3 to 16 inches: Very channery loam
16 to 20 inches: Unweathered bedrock

Description of Rock Outcrop

Properties and qualities

Slope: 35 to 90 percent
Depth to restrictive feature: 0 to 4 inches to paralithic bedrock

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)

Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability (nonirrigated): 8s

Typical profile

0 to 60 inches: Unweathered bedrock

Minor Components

Other soils

Percent of map unit: 20 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

93—Turley fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 5,000 to 5,800 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 125 days

Map Unit Composition

Turley and similar soils: 85 percent
Minor components: 15 percent

Description of Turley

Setting

Landform: Stream terraces, valley floors, fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous, mixed alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Available water capacity: Very high (about 32.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 4e

Typical profile

0 to 4 inches: Fine sandy loam
4 to 60 inches: Clay loam, silty clay loam, loam

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

94—Turley fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 5,000 to 5,800 feet

Mean annual precipitation: 8 to 12 inches

Mean annual air temperature: 45 to 50 degrees F

Frost-free period: 105 to 125 days

Map Unit Composition

Turley and similar soils: 85 percent

Minor components: 15 percent

Description of Turley

Setting

Landform: Stream terraces, fans, valley floors

Landform position (three-dimensional): Talf

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Calcareous, mixed alluvium derived from sandstone
and shale

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately high (0.20 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/
cm)

Available water capacity: Very high (about 32.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability (nonirrigated): 6e

Typical profile

0 to 4 inches: Fine sandy loam

4 to 60 inches: Clay loam, silty clay loam, loam

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

95—Uffens loam, 0 to 5 percent slopes

Map Unit Setting

Elevation: 5,100 to 5,800 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 130 days

Map Unit Composition

Uffens and similar soils: 85 percent
Minor components: 15 percent

Description of Uffens

Setting

Landform: Stream terraces, fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous, saline alluvium

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Moderately saline to strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum: 35.0
Available water capacity: Very high (about 14.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability (nonirrigated): 7s

Typical profile

0 to 2 inches: Loam
2 to 19 inches: Sandy clay loam, clay loam, silty clay loam
19 to 60 inches: Sandy clay loam, loam, clay loam

Minor Components

Other soils

Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado

Survey Area Data: Version 8, May 3, 2011

Rio Blanco County Area, Colorado

129—Water

Map Unit Composition

Water: 95 percent

Minor components: 5 percent

Minor Components

Aquolls

Percent of map unit: 5 percent

Landform: Marshes

Data Source Information

Soil Survey Area: Rio Blanco County Area, Colorado


Survey Area Data: Version 8, May 3, 2011

40° 4' 57"

Custom Soil Resource Report

MAP LEGEND -Western RWSU


Area of Interest (AOI)


 Area of Interest (AOI)


Soils


 Soil Map Units

Soil Ratings

 R034XY403CO — Clayey
Salt-desert


 R034XY406CO —
Salt-desert Breaks

 R048AY287CO — Stony
Foothills

 Not rated or not available


Political Features

 Cities

 PLSS Township and
Range

 PLSS Section

Water Features


 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

MAP INFORMATION

Map Scale: 1:43,900 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 12N NAD83

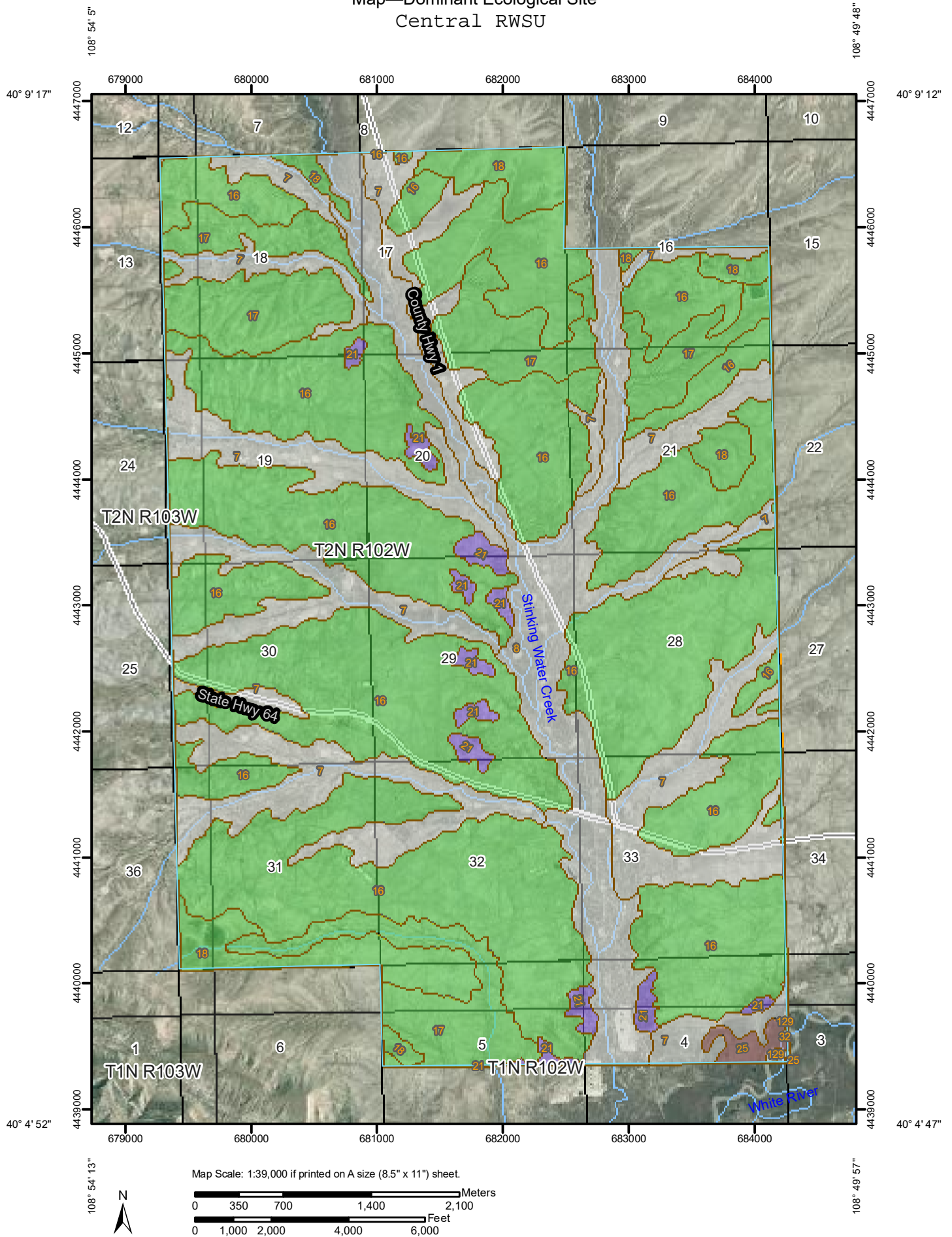
This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rio Blanco County Area, Colorado
Survey Area Data: Version 8, May 3, 2011

Date(s) aerial images were photographed: 7/14/2006; 8/7/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.


Custom Soil Resource Report
Map—Dominant Ecological Site
Central RWSU



Custom Soil Resource Report

MAP LEGEND -Central RWSU


Area of Interest (AOI)


 Area of Interest (AOI)


Soils


 Soil Map Units

Soil Ratings

 R034XY402CO — Sandy
Salt desert

 R034XY403CO — Clayey
Salt desert

 R034XY406CO —
Salt desert Breaks

 Not rated or not available


Political Features

 Cities

 PLSS Township and
Range

 PLSS Section

Water Features


 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

MAP INFORMATION

Map Scale: 1:39,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 12N NAD83

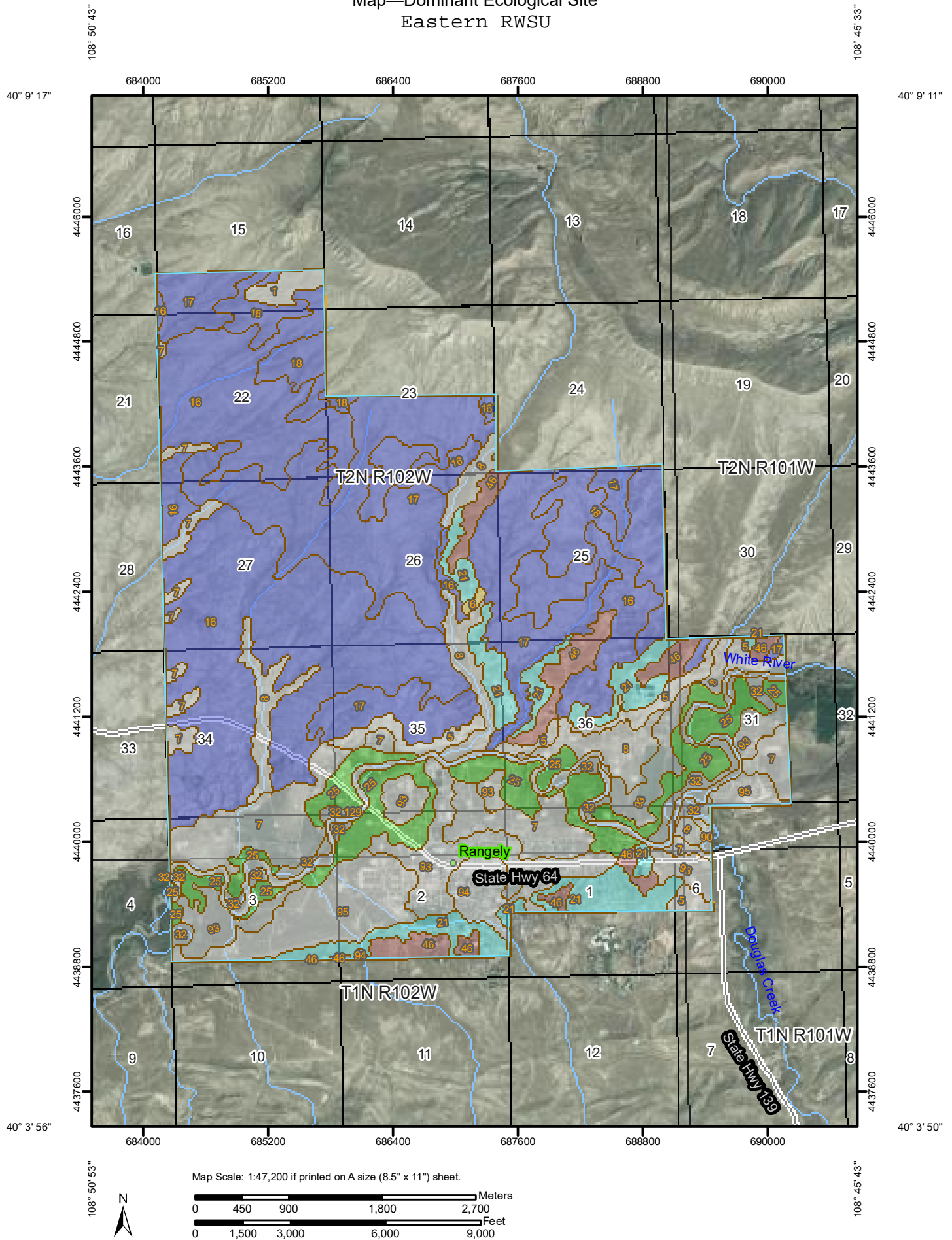
This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rio Blanco County Area, Colorado
Survey Area Data: Version 8, May 3, 2011

Date(s) aerial images were photographed: 8/7/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.


Custom Soil Resource Report
Map—Dominant Ecological Site
Eastern RWSU



Custom Soil Resource Report

MAP LEGEND - Eastern RWSU


Area of Interest (AOI)


 Area of Interest (AOI)


Soils


 Soil Map Units


Soil Ratings


 R034XY401CO — Loamy
Salt desert

 R034XY402CO — Sandy
Salt desert

 R034XY403CO — Clayey
Salt desert


 R034XY406CO —
Salt desert Breaks


 R048AY285CO — Foothill
Swale

 Not rated or not available

Political Features

 Cities

 PLSS Township and
Range

 PLSS Section

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes



Major Roads

MAP INFORMATION

Map Scale: 1:47,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rio Blanco County Area, Colorado
Survey Area Data: Version 8, May 3, 2011

Date(s) aerial images were photographed: 8/7/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service, Colorado

Technical Guide
Section II E

RANGE SITE NO. 403
Field Office
August 1975

RANGE SITE DESCRIPTION

for

CLAYEY SALTDESERT

Land Resource Area: Central Desertic Basins, Mountains,
and Plateaus (34)
Colorado and Green Rivers Plateaus (35)

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

Topography is generally hilly, hummocky, or undulating terrain, located between main valley floors and more precipitous hills. The site is also on some broad ridges between drainageways on desert-like expanses. It is dissected by gullies, forming a highly dendritic drainage pattern in most cases. Gullies are encountered frequently on steeper slopes.

Slopes range between about 3 and 25%, the major area of the site is on slopes of 6 to 20%. Slopes do not have a significant influence on plant growth. Elevation ranges from 4500 to 6500 feet.

2. Climatic Features

Average annual precipitation is 8 to 12 inches. About 30 to 40% falls during the period November through March. From mid-April to mid-July the climate is normally dry. Wide yearly and seasonal fluctuations are common.

Major native plants make their main growth from mid-March to mid-May, primarily on stored winter moisture. There is sometimes fall growth from late summer rains. Mean annual temperature is about 50° to 54° F, averaging about 30° for the winter and 60° F through the growing season, March through October. Summer temperatures of 100° F or more are not unusual. Frost-free period is generally 150 days or more. April and May are usually windy. Average annual moisture deficit is high--more than 50 inches. Moisture that comes during hot summer weather does little for plant growth, except for some in late summer.

3. Native (potential) Vegetation

This is primarily a mat saltbush-Gardner saltbush association, with a few other plants scattered through the stand. On some areas, Gardner saltbush is a clear dominant; on others it is minor. Shadscale is important in places. Grasses, mostly galleta or a mixture of galleta and Salina wildrye, are patchy and do make up more than 1/3 the annual yield. Alkali sacaton shows up in the Four-Corners region, but is not present on much of the site. Squirreltail and Indian ricegrass are usually present in small amounts. Also growing here are globemallow, sego lily, woody aster, buckwheat, spiny horsebrush, low Douglas rabbitbrush, prince's plume, prickly pear, locos and poisonvetches, phlox, snakeweed, buscuit root, wild onion, and primrose.

Native (potential) Vegetation and Guide for Determining Range Condition.

Percentage composition by weight of the principal species may total as much as:

Gardner saltbush	30
Mat saltbush	30
Shadscale	30
Galleta	20
Salina wildrye	10
Alkali sacaton	10
Indian ricegrass	5
Squirreltail	5
Others (as listed above)	10

There are no tree species.

Ground is sparsely covered and rarely exceeds 15 to 20 percent.

Species most likely to invade are cheatgrass and introduced annual forbs such as Russian thistle and, in places, halogeton. Native annual saltweeds may increase significantly from trace amounts as the ecological condition deteriorates. Grasses decline drastically under continued deterioration and may nearly disappear. In some cases mat saltbush and Gardner saltbush become almost the only plants.

4. Total Annual Production

Favorable years	500	Pounds	per	Acre	Air	Dry
Unfavorable years	200	"	"	"	"	"
Median years	350	"	"	"	"	"

5. Soils

a. Surface textures are clayey, ranging from heavy silty clay loams to clays and silty clays. In some areas there may be slight stone litter or a light coating of lag gravels on the surface. The soils are usually limy to the surface and typically grayish in color and high in salts. They are normally shallow, but may include minor areas of moderately deep soils. They are slowly permeable. High runoff and natural erodibility is typical. The predominant parent material is a gray member of the Mancos shale formation.

b. Soils in this site are:

6. Rare, Threatened or Endangered Plants and Animals

(To be added when known)

7. Location of Typical Example of the Site

- Along Hiway 164, near Aztec Wash, about 10 miles northwest of the Four Corners in Montezuma County. (Ute Mountain Indian Reservation).
- Indian Wash, near Grand Junction airport, Mesa County.
- Oil fields north of Rangely, Rio Blanco County
- BLM enclosure, 3 miles east of Massadona on U.S. 40 and 2 miles south, Moffat County.

8. Field Offices in Colorado where the site occurs:

314	Cortez
315	Craig
318	Delta
328	Grand Junction
343	Meeker
345	Montrose
346	Norwood

RANGE SITE DESCRIPTION - Colorado - 1974

B. Major Uses and Interpretations for the CLAYEY SALTDESERT Range Site

Use of Product	Value Rating			
	High	Medium	Low	Not Appli- cable
1. <u>Grazing</u>				
<u>Cattle</u>			X	
<u>Sheep</u> —	Winter	Overall		
<u>Horses</u>			X	
				X
2. <u>Wood Products</u>				
3. <u>Wildlife</u>				
<u>Antelope</u>		X		
<u>Bison</u>				X
<u>Deer</u>			X	
<u>Elk</u>				X
<u>Cottontail</u>			X	
<u>Jackrabbit</u>			X	
<u>Upland game birds</u>			X	
<u>Waterfowl</u>				X
<u>Prairie dog</u>		X		
4. <u>Watershed</u>				
			X	
5. <u>Recreation and Natural Beauty</u>				

Ecological Reference Sheet

MLRA: 34A Ecological Site: Clayey Salisdust

Date: 01/19/05 Author(s)/participant(s): J. Murray, C. Halverson, L. Santana, F. Cummings, S. Isenman

Contact for lead author:

This must be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: X Annual Production, Cover Produced During Current Year, Biomass

Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers (2) include expected range of values for above- and below-ground roots and natural disturbance regimes for each community within the reference state, when appropriate & (3) cite data. Consider descriptions on separate sheets.

1. Number and extent of rills. Rills are inherent to the site. Generally linear and most apparent on steeper slopes where ground cover has been reduced.

2. Presence of water flow patterns. Flow water expected seasonally continuous.

3. Number and height of erodible pedestals or terraces. Shale nodules common, occurring from new flow paths.

4. Raw ground from Ecological Site Description or other sensitive track, litter, lichen, moss, plant canopy are we have present. Exposed 50-60% raw ground. Pediment shrubs but water have present in terrace.

5. Number of galls and erosion associated with galls. None, depending on landscape position. Usually slanted with rounded edges. Galls are typically small and with spread unless flows have been to some point from old flow direction.

6. Extent of wind-eroded blowouts and/or deposition of sand. None.

7. Amount of litter movement (describe size and distance exposed in travel). Litter movement associated with flow paths. Movement is typically short (1-2 feet), but can be significant under intense rainfall events.

8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values). Stability also rating anticipated to be 2-3 in the reference state at soil surface.

9. Soil surface structure and SOM (soil organic matter) content. (Include type and strength of structure, and A horizon color and thickness). Surface texture ranges from heavy silty clay loam to clay and silty clay. Generally shallow but may include more areas of moderately deep loam and are slowly permeable. The A horizon ranges from 1-2 inches in depth, gray to light brownish gray in color with a finely to medium granular structure. Soils on this site can be either dispersive.

10. Effect of plant community composition (relative proportions of different functional groups & spatial distribution on resistance & runoff).

Grass and shrub canopy, basal cover, and inherent interference between plants over time help to control the reduction of overland flow. Infiltration on high clay soils is slow. Runoff happens!

11. Presence and thickness of compaction layer (usually none; describe soil profile features which may be attributed to compaction on this site). None.

12. Functional Structural Groups (list in order of descending dominance by above-ground production or by litter cover (usually) using symbols: >, <, = to indicate much greater than, greater than, and equal to; place dominants, subdominants and "others" on separate lines).

Dominate: \gg

Subdominate: warm season, intermediate grass & herbaceous forage

Other: \gg cool season, intermediate grass & warm season forage

13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence). Typically minimal. Expect slight stress and grass mortality/decadence during and following drought or lack of disturbance.

14. Average percent litter cover (_____ %) and depth (_____ inches). 5-10% litter cover at 0-25 inch depth. Litter cover declines during and following extended drought.

15. Expected annual production (this is TOTAL, above-ground production, not just forage production).

20 lbs/ac. low precip years. 30 lbs/ac. average precip years. 40 lbs/ac. above average precip years. After extended drought or the fire process above following wildfire, production may be significantly reduced by 10% - 25% for 1 or more years.

16. Potential invaders (including exotics) species (active and non-active). The species which characterize degraded states and which, after a threshold is crossed, "take" and often do, continue to increase regardless of the management of the site and may eventually dominate the site? Hairywood, Russian thistle, purple sandbar and other weedy species.

17. Potential plant reproductive capability. Variable due to sporadic moisture availability.

Functional/Structural Groups Sheet

State: _____ Officer: _____ Evaluated By: Cheryl Saltsford Site ID: K011545600

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[illegible]

Feature: whether each "structural/functional group" is a Dominant (D), (roughly 40-100% represented), a Sub-dominant (S), (roughly 10-20% represented), a Minor Component (M), (roughly 2-5% represented) or a Trace Component (T), (the representation based on weight or on a component is the area of interest (e.g., "Aster" relative to the "Pinus") - as determined from information found in the ecological interpretation and/or at the ecological reference site.

Biological Cross: *Leptocryptus* and *Leptocryptus* or other in combination, 8/11

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service, Colorado

Technical Guide
Section III E

RANGE SITE NO. 285
Field Office
August 1975

RANGE SITE DESCRIPTION

for

FOOTHILL SWALE

Land Resource Area: Central Desertic Basins, Mountains
and Plateaus (34)
Southern Rocky Mountains (48)

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occurs in the swales, valleys, alluvial bottomlands, and other low-lying areas which receive runoff from adjacent uplands.

Elevation ranges from 6000 feet to 7600 feet above sea level.

2. Climatic Features

Annual precipitation ranges between 12 to 16 inches, with about 60% coming as snow.

The optimum growing season for native plants is April 15 to July 15.

Due to its position, this site receives occasional beneficial moisture from run-in water and overflow water.

3. Native (potential) Vegetation

The aspect of this site is a valley grassland plant community with a rather sparse stand of shrubs, basin wildrye, western and streambank wheatgrasses, Indian ricegrass, squirreltail, and Nevada bluegrass are the dominant grasses. Shrubs include big sagebrush, rubber rabbitbrush, and fourwing saltbush. Principal forbs are yarrow, fleabane, globemallow, Indian paintbrush, and wild buckwheat.

Native (potential) Vegetation and Guide for Determining Range Condition.

Percentage composition by weight of the principal species may total as much as:

Grasses and grasslike:

Basin wildrye
Western wheatgrass
Streambank wheatgrass
Indian ricegrass
Squirreltail
Nevada bluegrass
Slender wheatgrass
Needle-and-thread
Beardless bluebunch wheatgrass
Bluebunch wheatgrass
Sand dropseed

Forbs:

Yarrow)
Bladderpod)
Fleabane)
Globemallow)
Indian paintbrush)
Wild buckwheat)
Herbaceous sage)

Shrubs: 10-15

Big sagebrush
Rubber rabbitbrush
Fourwing saltbush

75-85 1500-1700
50 J
10 f 5-10 100-200
10 f 10-15 200-300
5 S
5 S
5 S
3 S
3 S
2 g 700 1600 2500
2 f 95 150 200
2 f 195 250 325
S

Invaders of this site are cheatgrass, Kentucky bluegrass, cactus, thistle, lambsquarter, mustard, snakeweed, and greasewood.

4. Total Annual Production

Favorable years 3000 Pounds per Acre Air Dry
Unfavorable years 1000 " " " " "
Median years 2000 " " " " "

~~75-85 1500-1700~~
~~5-10 100-200~~
~~10-15 200-300~~

5. Soils

a. Deep, well drained, medium and moderately coarse textured soils. Brown and grayish brown surface soils 5 to 9 inches thick underlain by stratified loamy materials. These soils have good intake rates, good permeability, and a high water-holding capacity. Fertility levels are usually high. Soils are usually in the frigid family.

b. Soils in this site are:

Glendive fine sandy loam
Havre loam

6. Rare, Threatened or Endangered Plants and Animals

(To be added when known)

7. Location of Typical Example of the Site

Major drainages in the Piceance Basin, Rio Blanco County.

8. Field Offices in Colorado where the site occurs:

315 Craig
326 Glenwood Springs
328 Grand Junction
343 Meeker

RANGE SITE DESCRIPTION - Colorado - 1974

B. Major Uses and Interpretations for the FOOTHILL SWALE Range Site

Use of Product	Value Rating			
	High	Medium	Low	Not Appli- cable
1. <u>Grazing</u>				
<u>Cattle</u>		X		
<u>Sheep</u> —	X			
<u>Horses</u>		X		
2. <u>Wood Products</u>				X
3. <u>Wildlife</u>				
<u>Antelope</u>		X		
<u>Bison</u>		X		
<u>Deer</u>	X			
<u>Elk</u>		X		
<u>Cottontail</u>	X			
<u>Jackrabbit</u>				X
<u>Upland game birds</u>	X			
<u>Waterfowl</u>		X		
4. <u>Watershed</u>		X		
5. <u>Recreation and Natural Beauty</u>		X		

Ecological Reference Sheet

MLRA: 14A Ecological Site: Forthill Swale

Date: 01/19/15 Author(s)/participant(s): J. Murray, C. Holcomb, L. Santara, P. Cummings, S. Jensen

Contact for lead author:

This may be verified based on soils and climate (see Ecological Site description). Current plant community cannot be used to identify the ecological site.

Competition Indicators 1a and 1b based on: X Annual Production, Over Production During Current Year, Forages

Indicators. For each indicator, describe the potential for the site. When possible, (1) use numbers, (2) include expected range of values for above- and below-average years and critical disturbance regimes for each community within the reference data, when appropriate & (3) cite data. Confine descriptions to separate sheet.

1. Number and extent of fire scars

2. Presence of water flow patterns: None

3. Number and height of eroded pedestals or terraces: None

4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground). Paper 3 (life zone annual). Estimated drought can cause bare ground to increase.

5. Number of gullies and erosion associated with gullies: Bare, due to office influence. Shovel and shovel.

6. Extent of wind erosion, blowouts and/or depositional areas: None.

7. Amount of litter movement (describe size and distance expected to travel). Typically slight, however during major flooding events the soil does move (flow and various) litter and sediments.

8. Soil surface (top few mm) resistance to erosion (soil values are averages - some sites will show a range of values). Stability class being estimated to be 4-5 in the interspace at the soil surface.

9. Soil surface structure and SOM (soil organic matter) content (include type and strength of structure, and A horizon color and thickness). Soils are typically deep and well drained. Surface texture ranges from clay to loam to sand. The A horizon has some iron. All mixed with a light brownish gray to grayish brown. Surface shows a weak coarse clay parting to moderate fine granular.

10. Effect of plant community composition (relative proportion of different functional groups) & spatial distribution on infiltration & runoff. Diverse grass and shrub functional groups and diverse root structure patterns reduces runoff impact direct overland flow resulting increased time for infiltration to occur.

11. Presence and absence of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this sheet): None.

12. Functional/Structural Groups (list in order of decreasing dominance by above ground production or live foliar cover (specify) using symbols: >, <, = to indicate much greater than, greater than, and equal to; place dominants, subdominants and "others" as separate lines).

Dominant: cool season grasses

Sub-dominant: cool season fine leaved grass - shrubs

Other: forbs

13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): Minimal

14. Average percent litter cover (____ %) and depth (____) inches. Study's litter cover and depth from 0.5 to 1.0 inches or depth. Litter cover declines during and following extended drought.

15. Expected annual production (this is TOTAL above-ground production, not just forage production): 1000 lbs./ac. low precipitation years, 2000 lbs./ac. average precipitation years, 3000 lbs./ac. above average precipitation years. After extended drought, production may be reduced by 500 - 1000 lbs./ac. or more.

16. Potential invasive (including noxious) species (native and non-native). List species which characterize degraded states and which, after a threshold is crossed, "take over" and often do, contribute to increase degradation of the management of the site and may eventually dominate the site. Kentucky bluegrass, Canada thistle and other noxious weeds.

17. Perennial plant reproductive capability. The only limitations are weather-related wildfires, natural disease, inter-species competition, wildlife, excessive litter, and insects that may occasionally reduce reproductive capability.

Range Site No. 285
 Foothill Swale
 3/06

zone 103

Native (potential) Vegetation

Percentage/pounds composition by weight of the principal species may total as much as:

G 710
F 95
S 195
+ 1000
150
250
2000
205
325
3000

	75-85	%	LBS.
<u>Grasses and grasslike</u>			
- Basin wildrye	30	50	1000
- Western wheatgrass	5	10	200
- Streambank wheatgrass	5	10	200
- Indian ricegrass	1	5	100
- Squirreltail	1	5	100
- Nevada bluegrass	1	5	100
- Slender wheatgrass	1	3	60
- Needle-and-thread	1	3	60
- Beardless bluebunch wheatgrass	1	2	40
- Bluebunch wheatgrass	1	2	40
- Sand dropseed	1	2	40

100-200
20-100
20-60
20-40

<u>Forbs</u>	5	10	
Yarrow)		
Bladderpod)		
Fleabane)	10	200
Globemallow)		
Indian paintbrush)		
Wild buckwheat)		
Herbaceous sage		1	20

<u>Shrubs</u>	10	15	
- Big sagebrush	5	10	200
- Rubber rabbitbrush	2	5	100
- Fourwing saltbrush	2	5	100

Total Annual Production

Favorable years	3000 Pounds per Acre Air Dry
Unfavorable years	1000 " " " " "
Median years	2000 " " " " "

Note: Conversion (Median year X percent composition = lbs.)

MLRA: 45A Ecological Site: Forested Slope

Contact for lead author:

Organization Indicators (1) and (2) based on 5 Annual Indicators	Score (based on 2009 Survey Year)	Threats
--	-----------------------------------	---------

THE THREE CIRCLE RULE

3 - Bureau of Internal Revenue

3. Number and height of mineral particles or structures: 100

4. Data derived from Ecological News (Journalists or other sources) (tick, if any). Dates, times, locations are all as printed. Dates: 5/19/1994 printed. Estimated duration: 10 minutes. Data printed as follows:

3. Number of studies and cross-sectional studies with positive RRR, size and 95% confidence interval, forest and diamond plot

b. Exponent β was estimated. Estimates and standard deviation are as follows:

7. Attitude of (Rider movement) (overall size and distance expected or feared). (usually slight, increases during stage) (exceeds the average rider (New York) distance time and volume)

3. Soil surface top few centimeters to ensure reliability values are averages - most sites will show a range of values. Stability class ranges indicated to be 1-2 in the immediate at the soil surface.

4. Soil surface structure and SPM (soil organic matter) content: include type and strength of structure, and % by mass of soil organic matter. Soils are typically deep and well mixed. Surface texture ranges from silty clay loam to loam. The A horizon is made from 10 inches with a light brownish gray to grayish brown. Surface structure is weak and is partly parting to subangular blocky.

14. Effect of plant community composition (relative proportion of different functional groups) & species distribution on infiltration & runoff. Diverse grass and shrub communities (functional groups and species) and diverse tree communities (species and canopy structure) have moderate increases in infiltration to some extent. Runoff variability increases with the infiltration to some extent.

11. Estimate the thickness of compacted layer initially and, describe soil profile features which may be needed for construction of earth dam.

12. Functional/Structural Groups (list in order of decreasing dominance by above-ground production or by tiller count; specify using symbols: >, =, < to indicate much greater than, greater than, and equal to; place dominants, subdominants and "others" as separate lines):

[illegible]

100

Figure 1. Schematic diagram of the experimental setup.

12. Amount of plant mortality and decomposition (include which functional groups are expected to show mortality or decomposition)

14. Average percent litter cover: _____ % and depth: _____ inches. 10-45% litter cover and ranges from 0.5-1.0 inches in depth. Litter cover declines during and following extended droughts.

15. Expected annual production (this is TOTAL above-ground production, not just forage production):
 (14b) lbs. in low precipitation years; (14c) lbs. in average precipitation years; (14d) lbs. in above-average precipitation years. After extended drought, production may be reduced by 50% - 60% for up to three

15. **Parasitic invasive (including noxious) species (native and non-native).** The species which characterize degraded states or which, after a threshold is crossed, "can, and often do, continue to increase regardless of the management of the site and may eventually dominate the site." Kennedy (1990a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v,w,x,y,z and other numerous works).

17. **Personal place reproductive capability:** For this dimension we consider existing evidence, natural science, anthropological, ethnographic, and/or historical literatures, and scientific and social anthropological evidence that address the capability

Functional Structural Groups Sheet

State: _____ Office: _____ Ecological Site: Foothill Shrub Site ID: 2014Y2500

Observer: _____ Date: _____

Functional Structural Groups			Species List for Functional Structural Groups
Name	Potential ¹	Actual ²	Plant Names
Cool season bunch grasses	D		Basin wildrice, slender wheatgrass, native bluegrasses, bonchgrass, squeretail, blackchick wheatgrass, needle-and-thread
Cool season rhizomatous grass	S		Western wheatgrass, sevenbank wheatgrass
Shrubs	S		Big sagebrush, rabbitbrush, fourwing saltbush
Forbs	M		Western yarrow, bladderpod, daisy fleabane, scarlet gilia, yellow, Indian paintbrush, buckwheats
Noxious Weeds			
Invasive Plants			
Biological Crust ³			

Indicate whether each "structural/functional group" is a Dominant (D) (roughly 40-100% composition), a Sub-dominant (S) (roughly 10-40% composition), a Minor Component (M) (roughly 2-5% composition), or a Trace Component (T) (<2% composition), based on weight or cover composition in the area of interest (e.g., "Actual" column) relative to the "Potential" column derived from information found in the ecological site description and/or at the ecological reference area.

Biological Crust³ dominance is evaluated solely on cover not composition by weight.

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service, Colorado

Technical Guide
Section II E

RANGE SITE NO. 401
Meeker Field Office
August 1975

RANGE SITE DESCRIPTION

for

LOAMY SALTDESERT

Land Resource Area: Central Desertic Basins, Mountains,
and Plateaus (34)
Colorado and Green Rivers Plateaus (35)
San Juan River Valley Mesas and Plateaus (37)

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occupies the gently sloping to rolling uplands of the Salt Desert. Degree of slope ranges from 0 to 50%. Direction of slope is not a factor since the site is quite drouthy due to extremely low precipitation. Elevation ranges from 4500 feet to 6500 feet above sea level.

2. Climatic Features

Annual precipitation is less than 12 inches. About 50% of this comes in August and September. Optimum growing season for native plants is April to October. Winters are typically cold, averaging 30° F. Temperatures average about 60° F during the growing season.

Late May, June, and July are the driest months. April and May are usually windy.

3. Native (potential) Vegetation

The aspect of this site is a mixed grass-shrubby vegetation. About 75% of the production is made up of grasses. Galleta, Indian rice-grass, needle-and-thread, and squirreltail are the most frequently seen grasses. Shadscale and Gardner saltbush are conspicuous shrubs. Forbs of significance are biscuitroot, globemallow, Indian paintbrush, sego lily, and Hood's phlox. Other plants that grow on this site include Sandberg bluegrass, buckwheat, loco, winterfat, Douglas rabbitbrush, snakeweed, prickly pear, big sagebrush, bud sagebrush, and four-wing saltbush.

RANGE SITE NO. 401
LOAMY SALTDDESERT
August 1975

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Native (potential) Vegetation and Guide for Determining Range Condition.

Percentage composition by weight of the principal species may total as much as:

Grasses and grasslike:

Galleta	50
Indian ricegrass	10
Needle-and-thread	5
Bottlebrush squirreltail	5
Sandberg bluegrass and other natives	5

Forbs:

Biscuitroot)	
Scarlet globemallow)	
Indian paintbrush)	
Sego lily)	5
Hood's phlox)	
Buckwheat)	
Loco)	

Shrubs:

Shadscale	10
Gardner saltbush	10
Winterfat	5
Douglas rabbitbrush	5
Broom snakeweed)
Prickly pear)
Big sagebrush)
Bud sagebrush)
and other natives)
	3

This site is treeless. Optimum ground cover is 25 percent.

Invaders on this site are cheatgrass, halogeton, Russian thistle, and annual mustards.

4. Total Annual Production

Favorable years	800	Pounds	per	Acre	Air	Dry
Unfavorable years	500	"	"	"	"	"
Median years	700	"	"	"	"	"

5. Soils

- a. Soils in this range site are very fine sandy loams to loams which are moderately deep to deep. They are weakly developed and mildly affected by salt and alkali. Soils are well drained and have moderate water intake rates and waterholding capacities. They are often calcareous to the surface. These are productive Saltdesert soils.

- b. Soils in this site are:

Pin Blanco Soils:

Avalon loam

22

Blackston stony loam

46

Fruita fine sandy loam

66 (Rott's portion)

Fruita loam

Mesa loam

Nelman sandy loam

Youngston loam

6. Rare, Threatened, or Endangered Plants and Animals

(To be added when known)

7. Location of Typical Example of the Site

- a. Five miles north of Loma, Mesa County

L.C. Christensen BLM
Range north east of Rangely

- b. North of Irish Canyon on Highway 318, Moffat County

8. Field Offices in Colorado where the site occurs:

314 Cortez
315 Craig
318 Delta
326 Glenwood Springs
328 Grand Junction
343 Meeker
345 Montrose

RANGE SITE DESCRIPTION - Colorado - 1974

B. Major Uses and Interpretations for the Loamy Salt Desert Range Site

Use of Product	Value Rating			
	High	Medium	Low	Not Appli- cable
1. <u>Grazing</u>				
<u>Cattle</u>			X	
<u>Sheep</u>		X		
<u>Horses</u>			X	
2. <u>Wood Products</u>				X
3. <u>Wildlife</u>				
<u>Antelope</u>		X		
<u>Bison</u>			X	
<u>Deer</u>			X	
<u>Elk</u>			X	
<u>Cottontail</u>		X		
<u>Jackrabbit</u>		X		
<u>Upland game birds</u>		X		
<u>Waterfowl</u>			X	
4. <u>Watershed</u>			X	
5. <u>Recreation and Natural Beauty</u>		X		

Ecological Reference Sheet

MLRA: 14A Ecological Site: Loamy Badlands

Date: 12/8/04 Author(s)/participant(s): J. Murray, C. Holcomb, L. Santana, P. Cummings, A. Jones, P. Hillig, S. Jansen

Contact for lead author:

This sheet is verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Compositional indicators 12 and 13 based on: A Annual Production, Cover Produced During Current Year, Biomass

Indicators: For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years and natural disturbance regimes for each community within the reference area, when appropriate, & (3) cite data. Cite data descriptions on separate sheet.

1. Number and extent of rills. None to slight. If present, shallow and short.
2. Presence of water flow patterns. Flow paths expected, short and usually disconnected with debris. Some are washed as features through stone rippled scuffs.
3. Number and height of eroding pedestals or terraces. Pedestals common, occurring in or near flow paths.
4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground). Layers 2'-3' below ground. Exposed despite rain water bare ground to increase.
5. Number of gullies and erosion associated with gullies. None, depending on average profile.
6. Extent of wind-scoured, blowrock and/or depositional areas. Slight.
7. Amount of litter movement (describe size and distance expected to travel). Litter movement associated with flow paths. Movement is typically short (1-2 feet), but can be moderate under some rainfall events.
8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values). Stability index rating anticipated to be 4-5 in the homogeneous soil surface.
9. Soil surface structure and SOM (soil organic matter) content (include type and strength of structure, and A horizon color and thickness). Surface texture ranges from a fine sandy loam to loam with a weak platy structure varying to fine granular. The A horizon ranges from 1-4 inches in depth with a loam to light brown soils.
10. Effect of plant community composition (relative proportion of different functional groups & spatial distribution on infiltration & runoff). Grass and shrub canopy, bare cover, and lichenous interspaces between plants show for some erosion flow, providing a lot opportunity for infiltration to occur, especially during or after high intensity rainfall events.
11. Presence and thickness of compaction layer (usually none, describes soil profile features which may be obstacles for compaction on this site). None.
12. Functional Structural Groups (the 16 order of descending dominance by above-ground production or live below cover (modify) using symbols: >>>, > to indicate much greater than, greater than, and equal to, plus dominant subdominance and "others" on separate lists).
 Dominant: *Stipa sp.* *Stipa sp.* *Stipa sp.*
 Subdominant: *Stipa sp.* *Stipa sp.* *Stipa sp.*
 Other: *Stipa sp.* *Stipa sp.* *Stipa sp.*
13. Amount of plant mortality and decomposition (include which functional groups are expected to show mortality or decomposition). Typically minimal. Impact slight with and grass mortality (dead and dying) and following drought or loss of disturbance.
14. Average percent litter cover () No and depth () inches. 10-20% litter cover and 1-2 inch depth. Litter cover increases during and following extended drought.
15. Expected annual production (above ground production, not just forage production).
 1st yr. 100 lbs./acre, 2nd yr. 100 lbs./acre, 3rd yr. 100 lbs./acre, 4th yr. 100 lbs./acre, 5th yr. 100 lbs./acre, 6th yr. 100 lbs./acre, 7th yr. 100 lbs./acre, 8th yr. 100 lbs./acre, 9th yr. 100 lbs./acre, 10th yr. 100 lbs./acre.
 1st yr. 100 lbs./acre, 2nd yr. 100 lbs./acre, 3rd yr. 100 lbs./acre, 4th yr. 100 lbs./acre, 5th yr. 100 lbs./acre, 6th yr. 100 lbs./acre, 7th yr. 100 lbs./acre, 8th yr. 100 lbs./acre, 9th yr. 100 lbs./acre, 10th yr. 100 lbs./acre.
16. Potential invasive (including non-invasive) species (native and non-native). List species which characterize degraded states and which, after a threshold is crossed, can, and often do, tend to increase regardless of the management of the site and may eventually dominate the site. *Chenopodium* *Chenopodium* and other invasive weeds.
17. Potential plant reproductive capability. The only limitations are weather-related, wildlife, natural disease, intra-specific competition, wildfire, and insects that may temporarily reduce reproductive capability.

Functional Structural Groups Sheet

Size: _____ Office: _____ Principal Site: Leamy Settlement Site ID: EE34AY-0017.cs

Electronics: _____ **Time:** _____

Functional Structural Groups			Species List for Functional Structural Group
Name	Potential	Actual	Plant Names
Warm season Perennating grass	D		Culebra
Cool season bunch grass	S		Indian ricegrass, needle-and-thread, batfaced squirreltail, sandberg bluegrass
Shrubs	S		Stadscale, Gardner saltbrush, winterfat, leaf sagebrush, fourwing willow, greasy leavedleaf
Ferbs	M		Buckwheat, scarlet globe mallow, scarlet gilia, asters, daisy, phlox, egg fly, blackberry
Warm season bunch grass	T		Sand drossed, black grama
Nuisance Weeds			
Invasive Plants			
Wildflower Crab?	E		

Indicate whether each "structural functional group" is a **Resistant (R)** (roughly 40-100% decomposition), a **Subdominant (S)** (roughly 10-40% decomposition), a **Minor Component (M)** (roughly 5-10% decomposition), or a **Trace Component (T)** (2% decomposition). Indicate weight or mass percentage in the soil or substrate (e.g., "Actual" column) relative to the "functional" column derived from laboratory. Used in the ecological interpretation section of the ecological reference area.

Biological Tree² format is a standard, easy-to-use format compatible with all

Started

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service, Colorado

Technical Guide
Section II E

RANGE SITE NO. 402
Field Office
August 1975

RANGE SITE DESCRIPTION

for

SANDY SALTDESERT

Land Resource Area: Central Desertic Basins, Mountains,
and Plateaus (34)
Colorado and Green Rivers Plateaus (35)
San Juan River Valley Mesas and
Plateaus (37)

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

- ✓ This site is generally in upland position---gently sloping to rolling hills. Degree of slope ranges from 0 to 25 percent. Direction does not influence the site.
- ✓ Elevation ranges from 5000 feet to 6500 feet above sea level.

2. Climatic Features

- ✓ Annual precipitation is less than 12 inches. About 60 percent of this occurs as rain from May through September. Optimum growing season is April, May, September, and October. Growth begins in early March.
- ✓ Late May, June, and early July are usually the driest months.

3. Native (potential) Vegetation

- ✓ This is a grassland plant community, but quickly becomes shrub dominated with site deterioration. Important grasses are galleta, needle-and-thread, Indian ricegrass, sand dropseed, and squirrel-tail. Important shrubs include shadscale, big sagebrush, black sage, spiny and spineless hopsage.
- ✓ This site is treeless.
- Optimum ground cover is 20 percent.
- ✓ Invaders on this site are Russian thistle, halogeton, annual mustards, and cheatgrass.

RANGE SITE NO. 402
SANDY SALTDESERT
August 1975

Page 2

Native (potential) Vegetation and Guide for Determining Range Condition.

Percentage composition by weight of the principal species may total as much as:

Grasses and grasslike:

✓ Needle-and-thread	10	25
Indian ricegrass	5	10
✓ Sand dropseed	5	10
Galleta	3	5
Sandberg bluegrass	3	5
Squirreltail	3	5
Three-awn	1	3

45 60

Forbs;

✓ Globemallow	1	5
✓ Phlox	1	5
✓ Buckwheat	1	5
Aster	1	5
✓ Mentzelia	1	5
✓ Sandverbena	1	5
✓ Prickly pear cactus	1	5

5 15

Shrubs:

Shadscale	10	15
Big sagebrush and black sagebrush	10	15
✓ Small rabbitbrush	5	10
✓ Tail rabbitbrush	5	10
Douglas rabbitbrush	5	10
Smooth horsebrush	3	5
Spiny horsebrush	3	5
Ephedra	0	2
Winterfat	0	2
Fourwing saltbush	0	2

35 40

4. Total Annual Production

✓ Favorable years	700	Pounds	per	Acre	Air	Dry
Unfavorable years	300	"	"	"	"	"
Median years	500	"	"	"	"	"

5. Soils

- a. Light colored sandy loam to loamy sand moderately deep to deep. Permeability is rapid and water holding capacity is low making the soil quite droughty and plant production dependent on current precipitation.

- b. Soils in this site are:

20? - 60" deep

6. Rare, Threatened or Endangered Plants and Animals

(To be added when known)

7. Location of Typical Example of the Site

Ranches and low hills east of Green River, Brown's Park Refuge, Brown's Park, Moffat County, Colorado.

8. Field Offices in Colorado where the site occurs:

314 Cortez
315 Craig
318 Delta
328 Grand Junction
343 Meeker

RANGE SITE DESCRIPTION - Colorado - 1974

B. Major Uses and Interpretations for the Sandy Saltdesert Range Site

Use of Product	Value Rating				
	High	Medium	Low	Not Appli- cable	
1. <u>Grazing</u>					
<u>Cattle</u>			X		
<u>Sheep</u>		X			
<u>Horses</u>			X		
2. <u>Wood Products</u>				X	
3. <u>Wildlife</u>					
<u>Antelope</u>		X			
<u>Bison</u>			X		
<u>Deer</u>			X		
<u>Elk</u>			X		
<u>Cottontail</u>		X			
<u>Jackrabbit</u>		X			
<u>Upland game birds</u>		X			
<u>Waterfowl</u>			X		
4. <u>Watershed</u>			X		
5. <u>Recreation and Natural Beauty</u>		X			

Ecological Reference Sheet

MLRA: 14A Ecological Site: Sandy Sand desert

Date: 01/20/05 Author(s)/participant(s): C. Holcomb, F. Cummings, S. Jensen

Contact for lead author:

This sheet is verified based on site and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Compositional Indicators (I and II) based on: X Annual Production, Cover Produced During Current Year, Biomass

Indicators. For each indicator, describe the potential for the site. Where practical, (1) use numbers (2) include expected range of values for mean and below average years and natural disturbance regimes for each community within the reference state, where appropriate & (3) cite data. Contents descriptions on separate sheet.

1. Number and extent of rills: None
2. Presence of water flow patterns: Flow paths expected, short and locally discontinuous with few short flow channels after rainfall events.
3. Number and height of seasonal pedestals or terraces: Pedestals common, mostly around shrubs.
4. Bare ground from Ecological Site Description or other studies (rock, litter, dunes, moss, plant canopy area not bare ground): Exposed to 80% bare ground. Exposed drought can cause bare ground to increase.
5. Number of gullies and erosion associated with gullies: None, depending on landscape position & other influences.
6. Extent of wind-eroded, non-erosion or depositional areas: Slight to moderate on exposed areas.
7. Amount of litter movement (describe size and distance expected to travel): Litter movement associated with flow paths and disturbed areas. Movement is typically short (1-2 feet), but can be moderate under storm rainfall events.
8. Soil surface (the few mm) resistance to erosion (stability values are averages - most sites will show a range of values): Stability class values anticipated to be 2-4 in the interspaces at soil surface.
9. Soil surface structure and MPM (soil surface monitor) content (include type and strength of structure, and A horizon color and thickness): Soil, moderately well drained soil. Surface texture ranges from a sandy loam to fine sandy loam with a moderate to strong very fine to medium clay content. The A horizon is 3-5 inches in depth, pale brown to light brownish gray to color.
10. Effect of plant community composition (relative proportion of different functional groups) & spatial distribution on infiltration & runoff: Diverse shrub, grass and forb species contribute to diverse root structure patterns reduce surface erosion and increase infiltration providing increased time for infiltration to occur. Soil becomes progressively infiltration.
11. Presence and thickness of compaction layer (usually none, describe soil profile features which may be suitable for comparison on this site): None.
12. Functional Structural Groups (the in order of decreasing dominance by above-ground production or live fuel cover (expressed using symbols: > = to indicate much greater than, greater than, and equal to; plus dominant, subdominant, and "others" as separate term):
 Perennial shrubs >
 Subdominant and warm perennial grasses > warm season herbaceous > forbs >
 Cool, warm season annuals > grasses
13. Amount of plant mortality and disturbance (include which functional groups are expected to show mortality or disturbance): Typically minimal. Exposed light and soil are normally disturbed during and following drought.
14. Average percent litter cover (%) and depth (inches): 10-20% litter cover at 2 inch depth. Litter cover declines during and following extended drought.
15. Expected annual production (this is TOTAL above-ground production, not just forage production):
 350 lbs/acre for 1 year, 500 lbs/acre for 2 years, 500 lbs/acre for 3 years, 500 lbs/acre for 4 years, 500 lbs/acre for 5 years. After extended drought or fire the first growing season following wildfire, production may be significantly reduced by 10% - 25% due to stress.
16. Potential invaders (including noxious species (native and non-native). List species which characterize degraded states and which, after a threshold is crossed, "can and often do, continue to increase regardless of the management of the site and may eventually dominate the site": Cheatgrass, halimoloxys, annual grasses, Russian thistle, and quackgrass, and other noxious weeds.
17. Potential plant reproductive capability: The only limiting factor is weather related, whether natural disaster, fire, drought, competition, wildlife, and events that may temporarily reduce reproductive capability.

Functional Structural Groups Sheet

State: _____ Office: _____ Political Site: Sandy Nelsonson Site ID: 0114W0011

[illegible]

Indicate whether each "structural functional group" is a Dominant (D) (roughly 40-60% composition), a Sub-dominant (S) (roughly 10-20% composition), a Minor Component (M) (roughly 2-5% composition), or a Trace Component (T) (<2% composition) based on weight or mole composition at the site of interest (i.e., "Actual" condition) relative to the "Desired" scenario derived from information from the Ecological Stoichiometry section and the associated reference area.

Biological Context: *Amphispiza bilineata* is a small songbird with a complex social structure, including territoriality and parental care.

Appendix C

BLM Gold Book, Chapters 4 & 6

Surface Operating Standards and Guidelines for

Oil and Gas

Exploration and Development

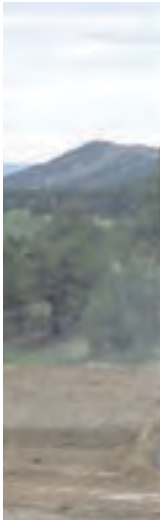
The Gold Book



Fourth Edition—2006



Chapter 4 – Construction and Maintenance



This chapter provides guidance for the operator about the basic requirements for safe and environmentally sound construction and maintenance of oil and gas-related infrastructure. Construction and maintenance must be performed to standards that ensure the long-term health and productivity of the land. The operator's representative must ensure compliance with all plans and designs. The representative should be designated prior to construction; be accessible to the surface

management agency authorized officer; have immediate access to an approved copy of the Application for Permit to Drill (APD), including all maps, drawings, templates, and construction standards; and have the authority to make changes at the request or order of the BLM or surface management agency.

Well Sites

Site Selection and Design

To the extent permitted by the geologic target, well spacing, and drilling and production technology, the locations selected for well sites, tank batteries, pits, and compressor stations should be planned so as to minimize long-term disruption of the surface resources and existing uses, and to promote successful reclamation. Design and construction techniques and other practices should be employed that would minimize surface disturbance and the associated effects of proposed operations and maintain the reclamation potential of the site. The following guidelines can be used to assist in meeting these objectives and reducing the overall undesirable impacts from well sites and other construction areas.

The site layout should be located and staked in the most level area, off narrow ridges, and set back

from steep slopes, while taking into consideration the geologic target, technical, economic, and operational feasibility, spacing rules, natural resource concerns, and safety considerations. Well locations constructed on steep slopes cost more to construct, maintain, and reclaim and result in greater resource impacts. Locations on steep slopes that require deep, nearly vertical cuts and steep fill slopes should be avoided where possible or appropriately mitigated. Operations should also be avoided or properly mitigated in riparian areas, floodplains, playas, lakeshores, wetlands, and areas subject to severe erosion and mass soil movement. In visually sensitive areas, locations should be selected that provide for vegetative and topographic screening. The well site or production facility location should also be reviewed to determine its effect on the location of the access road. The advantages gained by a good well site or tank battery location should not be negated by the adverse effects of the access road location.

Construction

Construction procedures must conform to the approved Surface Use Plan of Operations. In order to minimize surface disturbance, construction equipment appropriately sized to the scope and scale of the

proposed operation should be used. All surface soil materials (topsoil) are to be removed from the entire cut and fill area and temporarily stockpiled for reuse during interim and final reclamation. The depth of topsoil to be removed and stockpiled should be determined at the onsite inspection and should be stated either in the proposed Surface Use Plan of Operations or specified in the APD conditions of approval.

Topsoil should be segregated and stored separately from subsurface materials to avoid mixing during construction, storage, and interim reclamation. Subsurface materials should never be placed on top of topsoil material at any point in the operation. Stockpiles should be located and protected so that wind and water erosion are minimized and reclamation potential is maximized.

Excavation of the cut and fill slopes is normally guided by information on the slope stakes. Fills should be compacted to minimize the chance of slope failure. If excess cut material exists after fill areas have been brought to grade, the excess material will be stockpiled at approved locations. Snow and frozen soil material is not to be used in construction of fill areas and dikes or berms. To reduce areas of soil disturbance, the surface management agency may allow mowing or brush beating of vegetation for parts of the well location or access road where excavation is not necessary.

The area of the well pad where the drilling rig substructure is located should be level and capable of supporting the rig. The drill rig, tanks, heater-treater, and other production equipment are not to be placed on uncompacted fill material. The area used for mud tanks, generators, mud storage, and fuel tanks should be at a slight slope, where possible, or a suitable alternative, such as ditching, should be used to provide surface drainage from the work area to the pit.

To reduce erosion and soil loss, it may be appropriate to divert storm water away from the well location with ditches, berms, or waterbars above the cut slopes and to trap well location runoff and sediments on or near the location through the use of sediment fences or water retention ponds.

Reserve Pits

Reserve pits are generally used for storage or disposal of water, drill mud, and cuttings during drilling operations. The pit should normally be located entirely in cut material. Avoid constructing reserve pits in areas of shallow groundwater. Reserve pits should not be constructed in natural watercourses. Water courses include lake beds, gullies, draws, streambeds, washes, arroyos, or channels that are delineated on a 1:24,000 USGS quadrangle map or have a hydrologic connection to streams, rivers, or lakes.

For reserve pit construction on steeply sloping sites, the preferred method is to locate the pit on the drill pad next to the high wall. Pits are constructed totally in cut at such locations. If this is not possible, at least 50 percent of the reserve pit should be constructed below original ground level to help prevent failure of the pit dike. Fill dikes should be properly compacted in lifts. The necessary degree of compaction depends on soil texture and moisture content. The pit should be designed to contain all anticipated drilling muds, cuttings, fracture fluids, and precipitation while maintaining at least 2 feet of freeboard.

Pits improperly constructed on slopes or poor soil types may leak along the plane between the natural ground level and the fill. There is a significant potential for pit failure in these situations. When constructing dikes for pits or impoundments with fill embankment, a keyway or core trench should be excavated to a minimum depth of 2 to 3 feet below

the original ground level. The core of the embankment can then be constructed with compacted, water-impervious material.

To prevent contamination of ground water and soils or to conserve water, it is recommended that operators use a closed-loop drilling system or line reserve pits with an impermeable liner, particularly when it is anticipated that pits will contain moderate or high levels of hydrocarbons and chloride, or the pits are located in areas of shallow groundwater or porous soils over fractured bedrock aquifers.

Pits can be lined with synthetic liners or other materials such as bentonite or clay. Impermeable liners should have a permeability of less than 10^{-7} cm/sec. Liners must be installed so that they will not leak and must be composed of materials compatible with all substances to be placed in the pit. Synthetic liners with a minimum thickness of 12 mils and resistance to ultraviolet radiation, weathering, chemicals, punctures, and tearing are most commonly used, although some States may require liners that are thicker. Suitable bedding material, such as sand, clay, or felt liners should be used in areas where the base rock might puncture the liner.

Depending on the proposed contents of the pit and sensitivity of the environment, the surface management agency may require a leak detection system or the use of self-contained mud systems with the drilling fluids, mud, and cuttings being transported to approved disposal areas.

Reserve pits should be appropriately fenced to prevent access by persons, wildlife, or livestock. During drilling in active livestock areas, the reserve pit must be fenced with an enclosure fence on three sides and then fenced on the fourth side once drilling has been completed. Refer to Figure 1 for recommended fence construction standards in active livestock areas. In areas where livestock will not be present, other types of fences may be appropriate.

The fence should remain in place until pit reclamation begins. After cessation of drilling and completion operations, any visible or measurable layer of oil must be removed from the surface of the reserve pit and the pit kept free of oil. In some situations and locations, precautions, such as netting, may be required in order to prevent access and mortality of birds and other animals.

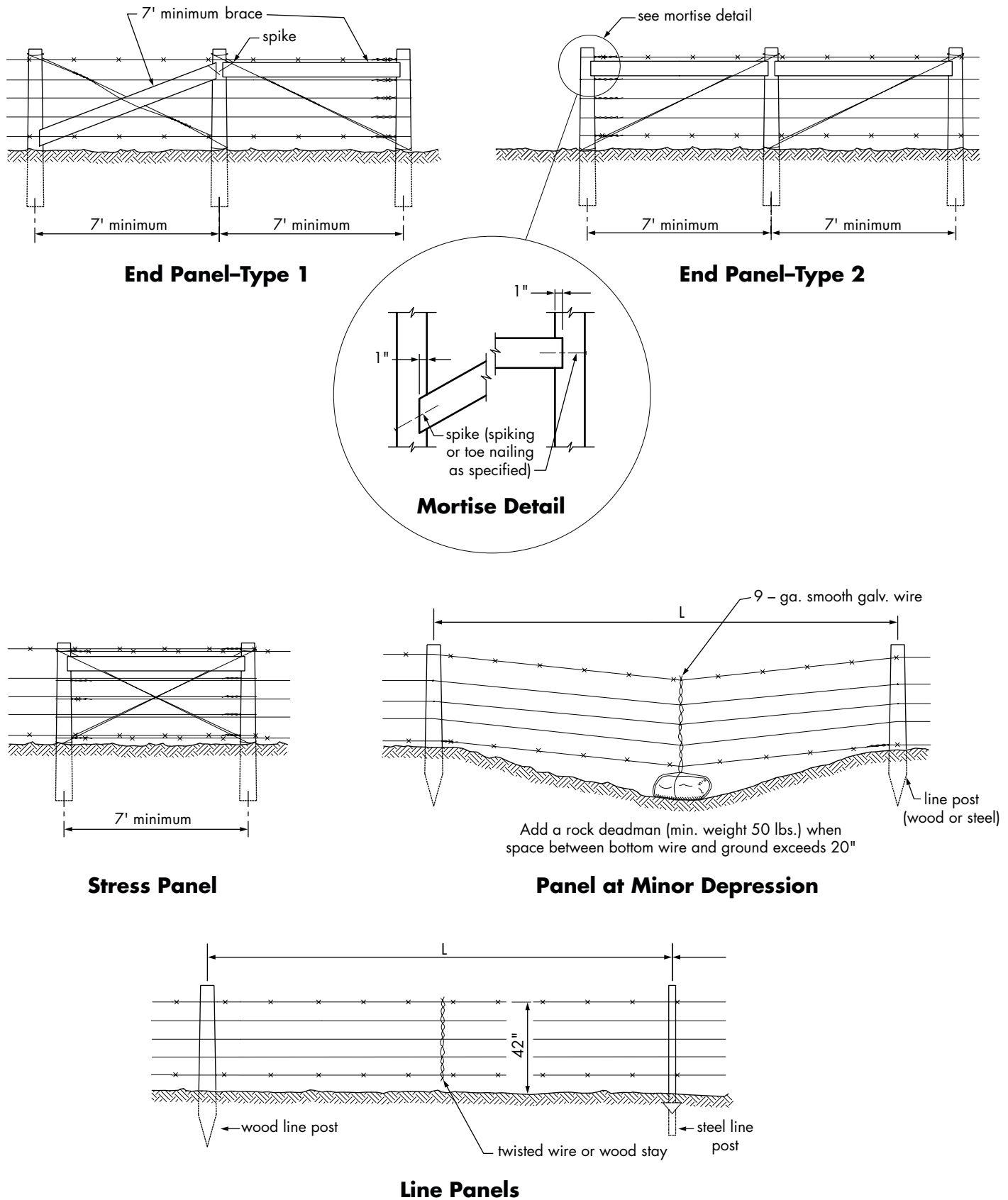
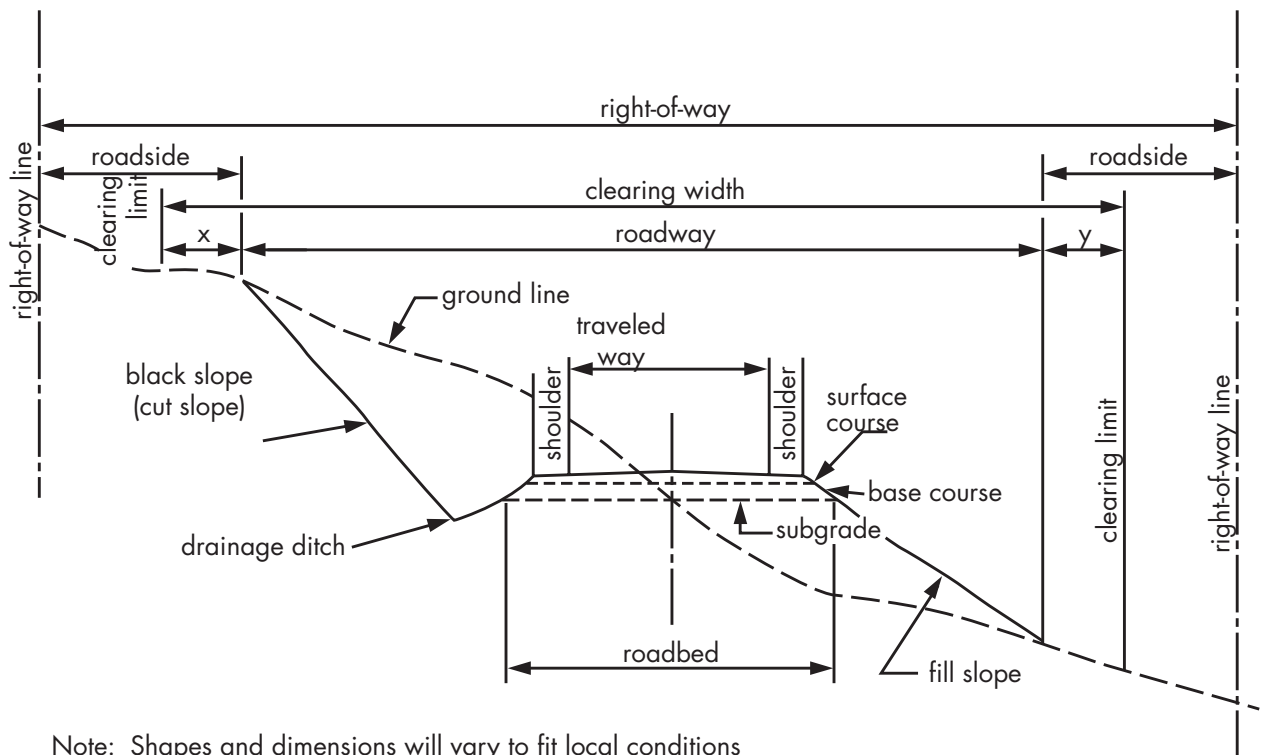


Figure 1. Recommended construction standards for exclosure fences in livestock areas.

Roads and Access Ways

This section provides the minimum guidelines for oil and gas operators on BLM and FS policy and standards relative to the planning, location, design, construction, maintenance, and operation of roads and access ways on public and National Forest

System lands. Contact the local BLM or FS office for specific requirements. Exception to or modification of these guidelines is at the surface management agency's discretion based on the physical conditions at the site and the project proposal. Figure 2 illustrates commonly used terms in road design and should be referred to when reviewing this section.



Note: Shapes and dimensions will vary to fit local conditions
See drawings for typical sections
x and y denote clearing outside of roadway

Figure 2. Illustration of commonly used terms in road design

To ensure public safety and the protection of Federal resources, BLM and FS roads must be constructed to an appropriate standard no higher than necessary to accommodate the intended use. In many cases, the construction of a lower-class road will meet the operator's access needs, while minimizing the effects on other important resource values.

Roads used to access oil and gas locations are typically constructed for that primary purpose, are rarely permanent, and exist only as long as necessary to complete exploration and production operations. They are authorized with an accompanying

reclamation plan and are to be reclaimed after well and field operations are completed. In relatively rare cases, the surface management agency or surface owner may assume responsibility for the continued operation and maintenance of roads deemed necessary.

The authorized officer has the option of determining whether professional engineering design and construction oversight is necessary or whether the road can be constructed by the operator consistent with site-specific standards and approved road design templates (Figures 2 and 3). The need for professional engineering design and oversight should be based on factors such as topography, soils,

Construction Steps

1. Salvage topsoil
2. Construct road

3. Redistribute topsoil
4. Revegetate slopes

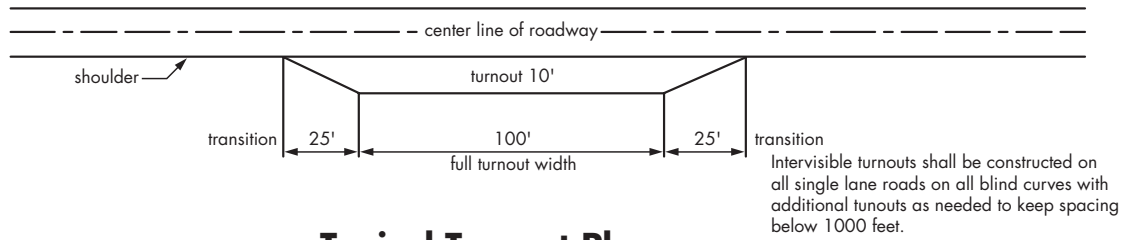
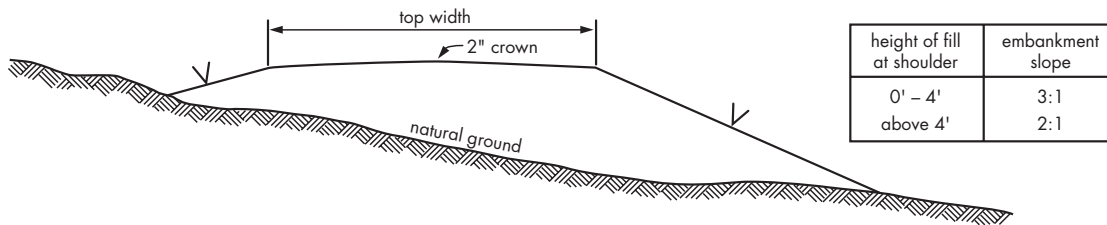
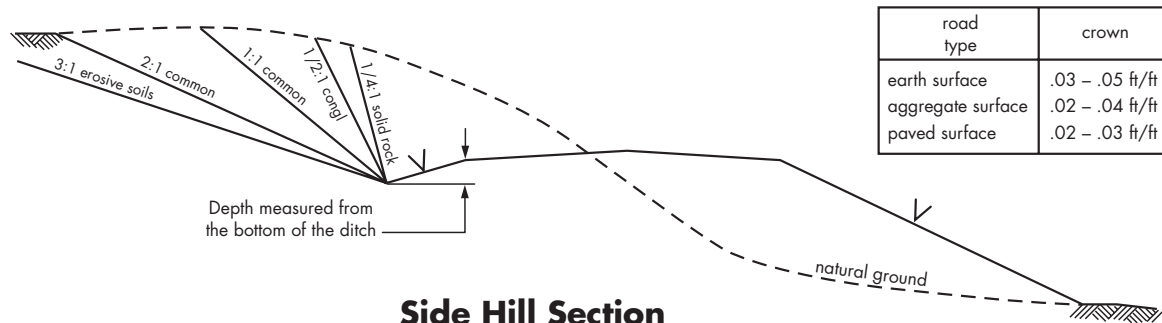
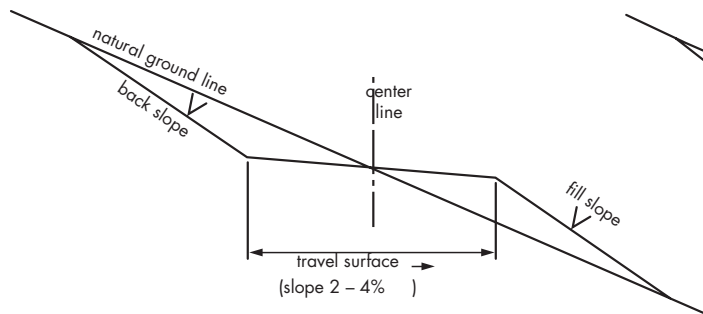
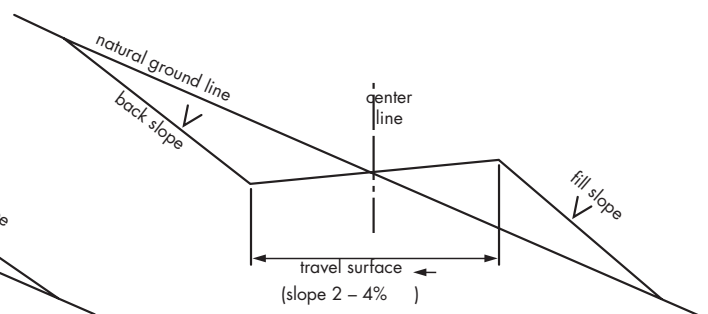
**Typical Turnout Plan****Embankment Section****Side Hill Section****Typical Outsloped Section****Typical Insloped Section**

Figure 3. Cross-sections and plans for typical road sections representative of BLM resource or FS local and higher-class roads.

hydrology, safety, and levels and types of use by the operator and general public. For oil and gas roads on National Forest System lands, a qualified FS engineer reviews all project design drawings, officially attesting to their technical adequacy.

To meet the requirements of Onshore Order No. 1 (Surface Use Plan of Operations, 2a and b) for new or reconstructed roads, the operator must provide information such as:

- Road width, maximum grade, and crown design
- Location of turnouts
- Plans for soils-, hydrology-, and topography-dependent drainage, including ditches and locations and sizes of culverts and bridges
- On- and off-site erosion control
- Plans for revegetation of disturbed areas
- Fence cuts and cattle guards
- Major cuts and fills
- Source and storage sites for topsoil
- Types of surfacing materials, if any
- Plans for maintaining or improving existing roads

All roads must be designed, constructed, and maintained by the operator in a safe and environmentally responsible manner. Oil and gas roads that are not closed to public use (through the use of gates or other traffic control devices) have the potential to serve secondary uses, such as providing access for hunters and other recreational users who may not be familiar with the road and area. Therefore, safety is a primary design consideration.

Roads also have the potential to cause environmental harm through erosion, air pollution, stream degradation, habitat alteration, and increased public use of an area. Careful attention to the proposed road location and design can significantly minimize environmental harm. For example, shorter roads constructed on steep slopes may cost more to construct, maintain, and reclaim and can also result in greater environmental impacts than would longer roads constructed along the contours of the land or constructed in flatter terrain. In areas of high environmental sensitivity, special road location, design, and construction and maintenance techniques may

be required, as well as seasonal vehicular closures to the general public.

It is always a good practice to consult with the surface management agency or private landowner prior to submitting the road design. Helpful design information can also be found on agency websites. For the BLM, guidance can be found in BLM 9113—Roads Manual; and BLM 9130—Sign Manual. For the FS, information is available in EM-7100-15: Sign and Poster Guidelines for the FS or the FS Water/Road Interaction Series of publications.

Transportation Planning

The goal of transportation planning is to identify and analyze feasible alternatives for access that meet the objectives of the surface management agency, private surface owner, and the needs of the diverse users of Federal lands. The transportation planning process:

- Considers future road use needs, including public access and resource development or use
- Considers affected resource values and safety
- Avoids haphazard or unnecessary development of roads and utility corridors

Road location and design criteria are also developed and documented during the transportation planning process. Transportation planning can prevent unnecessary expenditures of time and money and prevent unnecessary surface disturbance. Therefore, it is important for the operator to become involved in the transportation planning process.

Road Location

Road location is critical to the long-term maintenance and environmental success of a road construction project. Proper road location can significantly reduce or eliminate impacts to cultural, scenic, biological, and other environmental resources. Operators are strongly encouraged to contact the surface management agency or private surface owner about possible route locations before surveying and staking. This early communication between the operator and the surface management agency or private surface owner can minimize changes made at the onsite inspection and reduce project delays.

Existing roads should be considered for use as access routes and may be used when they meet agency standards, transportation and development needs, and environmental objectives. When access involves the use of existing agency roads, operators must obtain agency approval and may be required to upgrade the roads, contribute to road maintenance funds, or participate in road maintenance agreements.

When selecting a location for new roads, consider following topographic contours. While laying out roads in a point-to-point approach minimizes the length of road, it often increases soil erosion, maintenance costs, long-term loss of vegetation, and visual contrast. Following natural topographic contours preserves natural drainage patterns and usually makes it possible to design a more aesthetically pleasing road with lower construction, maintenance, and reclamation costs and less impact on the environment.

Initial steps in road location include:

- Determination of the intended use of the road, planned season of use, type of vehicles to be used, road class, and needs of the surface owner or agency
- Examination of the surface management agency's transportation plan, which may already have identified feasible routes for the area
- Examination of existing data, including maps and aerial photos, land use plan decisions, and biological, physical, and cultural conditions of the area
- Determination of oil and gas lease obligations, future development needs, and safety considerations.

Once these steps have been taken, an appropriate route can be identified. This process is critical to ensuring that the safest and least intrusive route is chosen.

Geotechnical Factors

In complex terrain or conditions, it is recommended that the operator look at various route alternatives before selecting the preferred route. Field reconnaissance of alternative routes may be necessary in order to provide information on such factors as soil types, construction/reclamation

limitations, type of excavation, landslide areas, subgrade conditions indicating the need for surfacing, potential cut slope problems, surface or subsurface water problem areas, suitability of fill material, potential gravel pits or quarries for road aggregate, and potential borrow and waste sites. A good road location analysis may avoid costly problems and identify cost-saving opportunities.

Other Factors

Other factors to consider that are unique to the oil and gas industry include:

- The potential for encountering sour gas (H₂S). Note the prevailing wind direction and identify a clear escape route from the drill site.
- The potential for year-round operation. Drill sites and producing locations may require all-weather access and special maintenance considerations for snow removal.
- The potential for exploratory drilling to result in a producing operation. Select initial road alignments and road classes based on the potential for upgrade if the wells are completed for production.

When the road location information is submitted to the surface management agency, the acceptability of the proposed route, and if applicable, alternative routes, can be evaluated. The preferred road location will be identified by the authorized officer at the onsite inspection in coordination with the private surface owner on non-Federal surface.

Road Design and Construction

Construction and Reclamation Considerations

New road construction or reconstruction by the operator must be suitable for the intended use and must comply with BLM road and safety standards, such as those found in BLM's 9113—Roads Manual. Roads constructed within the jurisdiction of the FS must comply with applicable FS road and safety standards.

Roads should be designed and constructed to allow for successful interim and eventual final reclamation.

mation. Revegetation of road ditches and cut and fill slopes will help stabilize exposed soils and reduce sediment loss, reduce the growth of noxious weeds, reduce maintenance costs, maintain scenic quality and forage, and protect habitat. To ensure successful growth of plants and forbs, topsoil must be salvaged where available during road construction and respread to the greatest degree practical on cut slopes, fill slopes, and borrow ditches prior to seeding. To ensure the stability of freshly topsoiled slopes during revegetation, the application of mulch or other sediment control measures may be appropriate.

Construction with saturated or frozen soils results in unstable roads and should be avoided. Vehicular travel under wet conditions can produce significant rutting of unsurfaced roads resulting in soil loss and safety concerns. If road use is anticipated during saturated soil conditions, the surface management agency may require road surfacing to provide safe vehicle access, ensure uninterrupted operations, and reduce road damage and sediment loss.

Nonconstructed Roads and Routes

When site conditions are appropriate, the surface management agency may approve the creation or use of "primitive," two-track roads or overland route corridors to meet the operator's access needs. Primitive roads and route corridors may serve as

appropriate access to exploration drilling locations where it is not certain if the well will be productive, or to producing wells where vehicle traffic is infrequent due to the use of off-site production facilities and automated well monitoring.

The appropriateness of primitive roads or routes is both site-specific and use-specific and is typically based on many factors, such as anticipated dry or frozen soil conditions, seasonal weather conditions, flat terrain, low anticipated traffic, or driller's or operator's access needs. Primitive roads or routes necessitate low vehicle speed and are typically limited to four-wheel drive or high clearance vehicles. They can consist of existing or new roads with minor or moderate grading; two-track roads created by the operator's direct vehicle use with little or no grading; overland routes within a defined travel corridor leaving no defined roadway beyond crushed vegetation; or any combination along the route. Operators should not flat-blade roads. Drainage must be maintained, where appropriate, to avoid erosion or the creation of a muddy, braided road.

These roads and routes must be used and maintained in a safe and environmentally responsible manner and are not intended for use as all-weather access roads. Resource damage must be repaired as soon as possible and the operator must consult with the surface management agency to determine if all



A minimum disturbance, primitive, two-track road winds its way to a drilling operation. To further reduce disturbance, most of the well location has not been stripped of vegetation or topsoil.

or a portion of the road needs to be upgraded to an all-weather access road. When used and maintained appropriately, nonconstructed roads and routes have the advantage of reducing construction, maintenance, and reclamation costs and reducing resource impacts. The use of nonconstructed roads must be approved by the surface management agency.

Constructed Roads

The surface management agency determines the appropriate road type and associated road design standards based on the expected traffic volume and other factors, such as seasonal or year-round use, the design vehicle, soil types, rainfall, topography, construction costs, compatibility with other resource values, and safety. This information is documented during the transportation planning process and onsite meeting. Road types may vary along the same route depending on the operator’s or the surface management agency’s access or resource protection needs. In some cases, exploration drilling may warrant a lower design standard or primitive road, mentioned previously, which could be upgraded if the well becomes a producing well.

BLM Resource or FS Local Roads

BLM resource or FS local roads are low-volume, single-lane roads. They normally have a 12 to 14 foot travelway with “intervisible turnouts,” as appropriate, where approaching drivers have a clear view of the

section of road between the two turnouts and can pull off to the side to let the approaching driver pass. They are usually used for dry weather, but may be surfaced, drained, and maintained for all-weather use. These roads connect terminal facilities, such as a well site, to collector, local, arterial, or other higher-class roads. They serve low average daily traffic (ADT) and are located on the basis of the specific resource activity need rather than travel efficiency.

BLM Local or FS Collector Roads

BLM local or FS collector roads may be single-lane or double-lane with travelways 12 to 24 feet in width and intervisible turnouts. They are normally graded, drained, and surfaced and are capable of carrying highway loads. These roads provide access to large areas and for various uses. They collect traffic from resource or local roads or terminal facilities and are connected to arterial roads or public highways. The location and standards for these roads are based on both long-term resource needs and travel efficiency. They may be operated for either constant or intermittent service, depending on land use and resource management objectives for the area being served.

BLM Collector or FS Arterial Roads

BLM collector or FS arterial roads are usually double-lane, graded, drained and surfaced, with a 20 to 24 foot travelway. They serve large land areas and are the major access route into development areas

**General Design Specifications
for Different Types of Roads**

Definitions

Design Criteria are requirements that govern the selection of elements and standards for a road, such as resource management objectives, road management objectives, safety requirements, and traffic characteristics.

Design Elements are the physical characteristics of a road, such as the ditches, culverts, travelway clearing limits, curve widening, slopes, and drainage characteristics that, when combined, comprise the planned facility.

Design Standards comprise the lengths, widths, and depths of design elements, such as a 14-foot-wide travelway, 2-foot shoulders, 2:1 cut slopes, 3-foot curve widening, and 6 inches of crushed aggregate. Design terms are illustrated in Figure 2.

Design Vehicle is the vehicle most frequently using the road that determines the minimum standard for a particular design element. No single vehicle, however, controls the standards for all the design elements for a road.

with high average daily traffic rates. The locations and standards are often determined by a demand for maximum mobility and travel efficiency rather than a specific resource management service. They usually connect with public highways or other arterials to form an integrated network of primary travel routes and are operated for long-term land and resource management purposes and constant service.

BLM Resource and FS Local Roads

Basic Design Requirements

The surface management agency will provide requirements specific to proposed oil and gas roads during project planning and/or at the onsite review with consideration of safety, impacts on land and resources, and cost of transportation. Requirements for specific proposals may vary somewhat from the generalized requirements that follow.

- Design speed specific to oil and gas roads is 10 to 30 miles per hour. For the FS, this should generally be less than 15 miles per hour.
- Preferred travelway width is 14 feet with turnouts. For the FS, this can vary from two parallel vehicle tracks, bladed 12-foot sections with turnouts, or a broader defined overland corridor approved by the surface management agency.
- Recommended minimum horizontal curve radii is determined by the design vehicle and design speed. Where terrain will not allow the proper curve radii, curve widening is necessary. Specifications are available from the surface management agency.
- Road gradient has a major effect on the environmental and visual impact of a road, particularly in terms of erosion. The gradient should fit as closely as possible to the natural terrain, considering vehicle operational limitations, soil types, environmental constraints, and traffic service levels. The gradient should not exceed 8 percent except for pitch grades (300 feet or less in length) in order to minimize environmental effects. In mountainous or dissected terrain, grades greater than 8 percent up to 16 percent may be permissible with prior approval of the surface management agency.
- The primary purpose of turnouts is for user convenience and safety and to maintain user speed.

Turnouts are generally naturally occurring, such as additional widths on ridges or other available areas on flat terrain. On roads open to the public, turnouts must be located at 1,000-foot intervals or be intervisible, whichever is less.

- Drainage control must be ensured over the entire road through the use of drainage dips, insloping, natural rolling topography, ditch turnouts, ditches, or culverts. Ditches and culverts may be required in some situations, depending on grades, soils, and local hydrology. If culverts or drainage crossings are needed, they should be designed for a 25-year or greater storm frequency, without development of a static head at the pipe inlet.
- Gravel or other surfacing is not always required, but may be necessary for "soft" road sections, steep grades, highly erosive soils, clay soils, or where all-weather access is needed.
- At times, a limited number of oil field vehicles (critical vehicles) larger than the design vehicle may make occasional use of the road. The operator should consider these needs in road design.

Field Survey Requirements

Field survey requirements vary with topography, geologic hazard, potential for public and recreational use, or other concerns. Each surface management agency has survey requirements based on design requirements and concerns specific to the area. The surface management agency should be contacted as early as possible to determine the survey requirements. The following general requirements are imposed to control work and produce the desired road.

- A flagline is established along the construction route. Flags should be placed approximately every 100 feet, or be intervisible, whichever is less.
- Construction control staking may be required depending on conditions of the site.
- Culvert installations are located and staked.

Design Drawings and Templates

- On side slopes of 0 to 20 percent, where horizontal and vertical alignment can be worked out on the ground, a plan and profile drawing may not be required. Standard templates, drainage dip spacing,

culvert locations, and turnout spacing guides would be acceptable.

- A plan and profile view would be the minimum drawing required on steeper slopes and in areas of environmental concern. The drawing should identify grade, alignment, stationing, turnouts, and culvert locations.
- Standard templates of road cross-sections and drainage dips are required for all resource, local, and higher-class roads. Figures 2 and 3 illustrate these sections.
- Additional information may be required in areas of environmental or engineering concern.

Construction

The operator must take all necessary precautions for protection of the work and safety of the public during construction of the road. Warning signs must be posted during blasting operations.

Clearing and Grubbing

Clearing and grubbing will normally be required on all sections of the road. Exceptions would be allowed in areas of sparse, non-woody vegetation.

All clearing and grubbing should be confined to a specified clearing width (Figure 2), which is usually somewhat wider than the limits of actual construction (roadway). Branches of all trees extending over the roadbed should be trimmed to provide a clear height of 14 feet above the roadbed surface. All vegetative debris must be disposed of as specified by the surface management agency.

Excavation

All soil material and fragmented rock removed in excavation is to be used as directed in the approved plan. Excess cut material shall not be wasted unless specified in the approved plan.

Roadbed Construction

Roadbed material should not be placed when the materials or the surface are frozen or too wet for satisfactory compaction. Equipment should be routed over the layers of roadbed material already in place to help avoid uneven compaction anywhere along the travel route. Borrow material

shall not be used until material from roadway excavation has been placed in the embankments, unless otherwise permitted. Borrow areas used by the operator must be approved prior to the start of excavation.

Roadside ditches should conform to the slope, grade, and shape of the required cross-section with no projections of roots, stumps, rocks, or similar debris. Side ditches must be excavated to a depth of 1-foot minimum below the finished road surface. Drainage turnout spacing on these ditches should not exceed 500 feet; slopes greater than 5 percent may require closer spacing of turnout furrows (wing ditches or relief ditches).

BLM Local and FS Collector Roads

Basic Design Requirements

- Design speed is generally 15 to 50 miles per hour. For the FS, it is 15 to 25 miles per hour. The selected design speed establishes the minimum sight distance for stopping and passing, and road geometrics such as minimum radius of curvature, the gradient, and type of running surface.
- Travelway minimum is 14 feet (single lane) and 24 feet (double lane) with intervisible turnouts, as may be required.
- Recommended minimum horizontal curve radius is 220 feet. Where terrain will not allow 220-foot curve radii, curve widening is necessary. Super-elevation should be considered at speeds greater than 20 miles per hour. Specifications are available from surface management agency engineering offices.
- Vertical curves should be designed with an appropriate "k" value (rate of vertical curvature length per percent of "A", the algebraic difference in grade) based on design speed (for example on FS, crest vertical curves, 30 mph k=9; 40 mph k=22; 50 mph k = 45).
- Maximum grades should not exceed 8 percent. Pitch grades for lengths not to exceed 300 feet may be allowed to exceed 8 percent in some cases.
- All culverts must be sized in accordance with accepted engineering practices and any special environmental concerns. The minimum size culvert in any installation is 18 inches. Drainage crossings

and culverts should be designed for a 25-year or greater storm frequency and allow fish passage in perennial streams where fish are present.

- Turnouts are required on all single-lane roads. Turnouts must be located at 1000-foot intervals or be intervisible, whichever is less. The length should not be less than 100 feet, with additional 50-foot transitional tapers at each end.
- Surfacing may be required to provide all-weather access. If surfacing is needed, aggregate size, type, amount, and application method will be specified by the local office of the surface management agency. Subgrade analysis may be required to determine load-bearing capacities.

Field Survey Requirements

Generally, the survey requirements for these roads are similar to those for BLM resource and FS local roads. These roads, however, are designed for higher average daily traffic rates and greater speeds. Thus, in addition to flagline and culvert survey requirements, an instrument or topographic survey with preliminary centerline staking and slope staking is usually required on steep terrain and in areas requiring special engineering. Specific survey requirements are available at the local office of the surface management agency.

Design Drawings and Templates

- Generally, the required drawings for this road class would include a plan and profile (Figure 4). The drawing should identify grade, location, stationing, surfacing, turnouts, culvert locations, and drainage dip spacing.
- Standard templates of the proposed road cross-section(s) (Figures 2 and 3) and drainage dip design are required for this type of road.
- Additional information may be required in areas of environmental or engineering concern.

Construction

- Drainage dips, construction, and spacing are the same as for BLM resource and FS local roads.
- Culvert cross-drains should be used in lieu of drainage dips for road grades in excess of 10 percent. Culvert installation is discussed in the Drainage and Drainage Structure Section.

- Construction standards are the same as given in the BLM Resource and FS Local Roads Section.

BLM Collector and FS Arterial Roads

Basic Survey and Design Requirements

- Vertical, horizontal, and topographic data, as well as significant features should be plotted on standard plan and profile sheets to a scale of 1 inch = 100 feet horizontal and 1 inch = 20 feet vertical, or as otherwise directed by the surface management agency. The design shall conform to the most current edition of the AASHTO, *Guidelines for Geometric Design of Very Low-Volume Local Roads*, for access roads with an anticipated average daily traffic of less than 400 vehicles.
- Plot "L" (layout) line along "P" (preliminary) line using the following design standards criteria:
 - Design speed is 30 miles per hour or greater unless otherwise directed.
 - Travel width-minimum is 20 feet, maximum is 24 feet.
 - Minimum horizontal curve radius is 460 feet unless shorter radii are approved. The curve radius must take into account super-elevation.
 - Design vertical curves with an appropriate "k" value based on design speed.
 - Maximum grade is 8 percent (except pitch grades not exceeding 300 feet in length and 10 percent in grade).
 - Mass diagrams and earthwork balancing may be required. Obvious areas of waste or borrow shall be noted on the plan and profile as well as proposed locations of borrow or waste disposal areas.
 - All culverts should be designed for a minimum 25-year storm frequency with an allowable head that does not overlap the roadway or cause damage. However, the minimum acceptable size culvert diameter is 18 inches. Show all culverts planned to accurate vertical scale on plan profile sheets.
 - Slope staking is required.

Design Drawings and Templates

- Complete plan and profile drawings are required for any BLM collector or FS arterial road (Figure 4). These drawings should identify grade, location, stationing, and all culvert sizes and locations (see Figure 7 for examples).
- Standard templates of road cross-sections, drainage design, and culvert location and installation are required (Examples in Figures 3 through 6).
- Mass diagrams and materials investigation and classification may be required.

Construction

Except for the specific items that follow, construction standards are given in the BLM Resource/FS Roads or the BLM Local/FS Collector Roads Sections. Construction shall be performed under the direction of a licensed, professional engineer as required by the BLM, or a qualified engineer for roads on FS lands.

Excavation and fill construction will be performed to secure the greatest practicable degree of roadbed compaction and stability. Roadbed materials

shall be placed parallel to the axis of the roadway in even, continuous, approximately horizontal layers not more than 8 inches in thickness. The full cross-section of the fill must be maintained as each successive layer is placed. Place successive layers of material on embankment areas to produce the best practical distribution of the material. The materials throughout the roadbed shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture, gradation, or compaction from the surrounding material. Ordinarily, stones coarser than a 3-inch-square mesh opening should be buried at least 4 inches below the finished surface of the roadway.

The operator should route construction equipment over the layers of roadbed material already in place and distribute the gravel evenly over the entire width of the embankment to obtain maximum compaction while placing the material and to avoid uneven compaction anywhere along the travel route.

Use excess excavation material, where practical, to improve the road grade line or to flatten fill slopes. Other waste areas must be approved prior to placement of waste material.

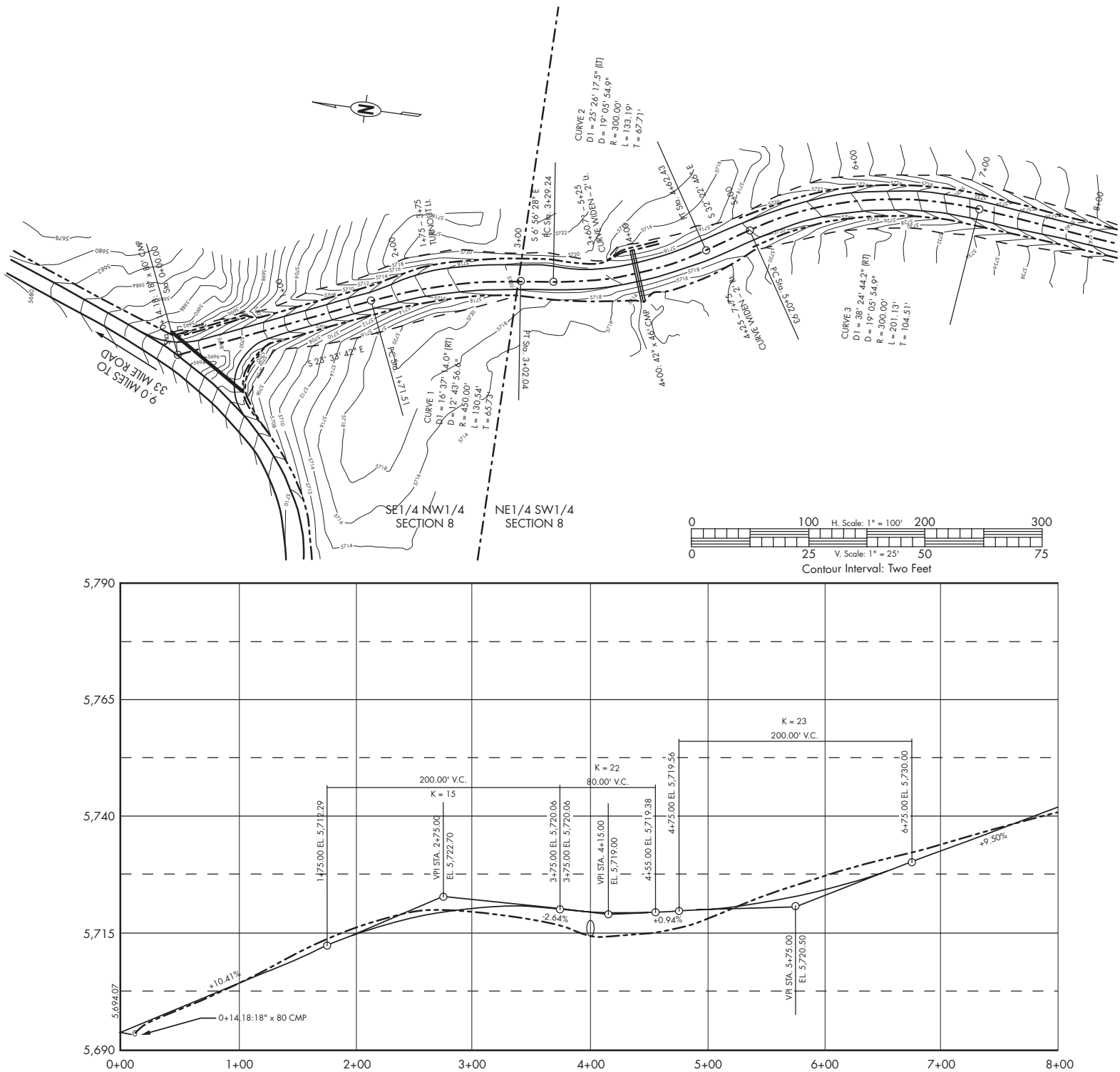


Figure 4. Typical road plan and profile drawing for an oil and gas road.

Road Maintenance

When required, the operator shall submit a road maintenance plan for all roads that will be constructed or used in conjunction with the drilling program. The maintenance plan will contain provisions for maintaining the traveled way, protection of the roadway features, requirements for road management, and the method to be used in carrying out maintenance activities.

Maintenance activities normally required include monitoring, blading, surface replacement, dust abatement, spot repairs, slide removal, ditch cleaning, culvert cleaning, litter cleanup, noxious weed control, and snow removal. When applicable, specific areas shall be identified in the road maintenance plan for disposal of slide material, borrow or quarry sites, stockpiles, or other uses that are needed for the project.

Key maintenance considerations include regular inspections; reduction of ruts and holes; maintenance

of crowns and outslopes to keep water off the road; replacement of surfacing materials; clearing of sediment blocking ditches and culverts; maintenance of interim reclamation; and noxious weed control.

Conduct additional inspections following snowmelt or heavy or prolonged rainfall to look for drainage, erosion, or siltation problems. Blade only when necessary and avoid blading established grass and forb vegetation in ditches and adjacent to the road. Ensure that maintenance operators have proper training and understand the surface management agency's road maintenance objectives.

Authorized users may perform their share of road maintenance, enter into road maintenance agreements administered by the users, or may be required to deposit sufficient funds with the surface management agency to provide for their share of maintenance. If the road has only one permitted user, other than incidental use by others, that user may have total responsibility for maintenance.



This example of interim road reclamation shows that reapplying topsoil and the regrowth of vegetation along the road borrow ditches of this resource road reduces the loss of forage, habitat, and sediment, decreases maintenance costs, and helps maintain the scenic quality.

Drainage and Drainage Structures

The proper design and construction of structures for the drainage of water from or through the roadway often contributes the most to the long-term success of the road and structure and minimizes maintenance and adverse environmental effects, such as erosion and sediment production. It is vitally important to keep the water off the road.

Road Drainage Design

The most economical control measure should be designed to meet resource and road management objectives and constraints. The economic considerations should include both construction and maintenance costs. The need for drainage structures can be minimized by proper road location. However, adequate drainage is essential for a stable road. A proper drainage system should include the best combination of various design elements, such as ditches, culverts, drainage dips, crown, in-slope or out-slope, low-water crossings, subsurface drains, and bridges.

Surface Drainage

Surface drainage provides for the interception, collection, and removal of water from the surface of roads and slope areas. The design may need to allow for debris passage, mud flows, and water heavily laden with silt, sand, and gravel. Culverts should be designed in accordance with applicable practices adopted by State and Federal water quality regulators under authority of the Federal Clean Water Act (CWA). Culverts should accommodate a 10-year flood without development of a static head and avoid serious velocity damage from a 25-year flood.

Subsurface Road Drainage

Subsurface drainage is provided to intercept, collect, and remove groundwater that may flow into the base course and subgrade; to lower high water tables; or to drain locally saturated deposits or soils.

Drainage Structures

Proper location and design can provide economical and efficient drainage in many cases. However, structural measures are often required to ensure proper and adequate drainage. Some of the most common structures are drainage dips, ditches, road crowning, culverts, and bridges.

Drainage Dips

The primary purpose of a drainage dip is to intercept and remove surface water from the travelway and shoulders before the combination of water volume and velocity begins to erode the surface materials. Drainage dips should not be confused with water bars, which are normally used for drainage and erosion protection of closed or blocked roads. See Figure 5 for an illustration of a typical drainage dip and construction specifications. Spacing of drainage dips depends upon local conditions such as soil material, grade, and topography. The surface management agency should be consulted for spacing instructions.

Ditches

The geometric design of ditches must consider the resource objectives for soil, water, and visual quality; maintenance capabilities and associated costs; and construction costs. Ditch grades should be no less than 0.5 percent to provide positive drainage and to avoid siltation. The types of ditches normally used are drainage, trap, interception, and outlet.

Road Crowning

Roads that use crowning and ditching are common and can be used with all road classes, except non-constructed roads. This design provides good drainage of water from the surface of the road.

Drainage of the inside ditch and sidehill runoff is essential if the travelway is to be kept dry and passable during wet weather.

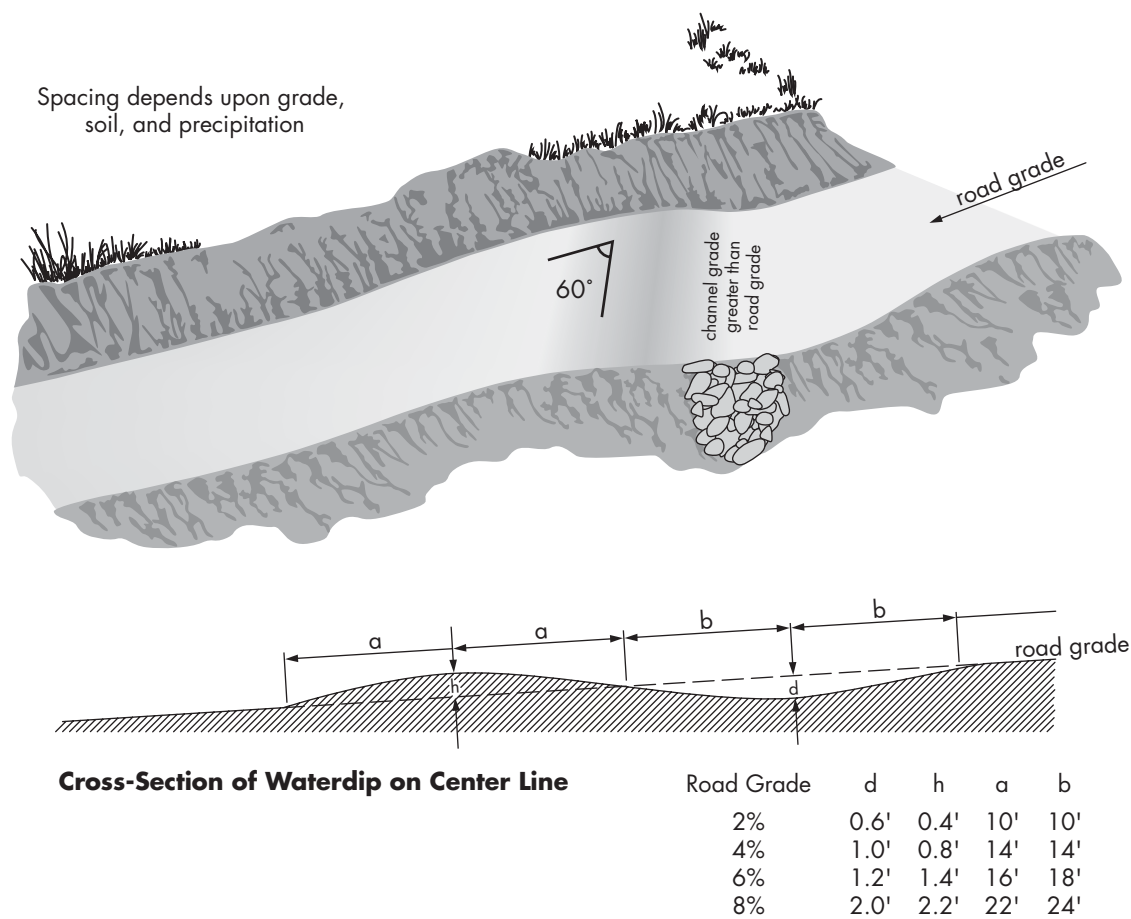


Figure 5. Typical drainage dip and construction specifications.

Culverts

Culverts are used in two applications: in streams and gullies to allow normal drainage to flow under the travelway and to drain inside road ditches. The latter may not be required if drainage dips are used. The location of culverts should be shown on the plan and profile or similar drawings or maps submitted with the APD.

All culverts should be laid on natural ground or at the original elevation of any drainage crossed, except as noted for ditch relief culverts. See Figures 6 and 7 for installation details.

Culverts should have a minimum diameter of 18 inches. The diameter should be determined by the anticipated amount of water that would flow through the culvert. Factors to be considered include the geographic area being drained, soils and slopes in the drainage area, annual precipitation, and likely storm events.

The outlet of all culverts should extend at least 1 foot beyond the toe of any slope. It may be necessary to install rip-rap or other energy dissipation devices at the outlet end of the culvert to prevent soil erosion or trap sediment (see example in the photograph).



Properly sized rock rip-rap at culvert outlets helps reduce water velocity and resulting soil erosion.

Maximum Recommended Culvert Spacing (ft)

Soil Type	Road Grade 2–4%	Road Grade 5–8%	Road Grade 9–12%
Highly erosive granitic or sandy	240	180	140
Intermediate erosive clay or loam	310	260	200
Low erosive shale or gravel	400	325	250

Figure 6. Culvert spacing.

All culverts used in the construction of access roads should be concrete, corrugated metal pipe made of steel, or properly bedded and backfilled corrugated plastic pipe. Only undamaged culverts are to be used, and any culvert should be inspected for damage prior to installation. All spots on the pipes where the zinc coating has been injured should be painted with two coats of zinc-rich paint or otherwise repaired as approved by the surface management agency.

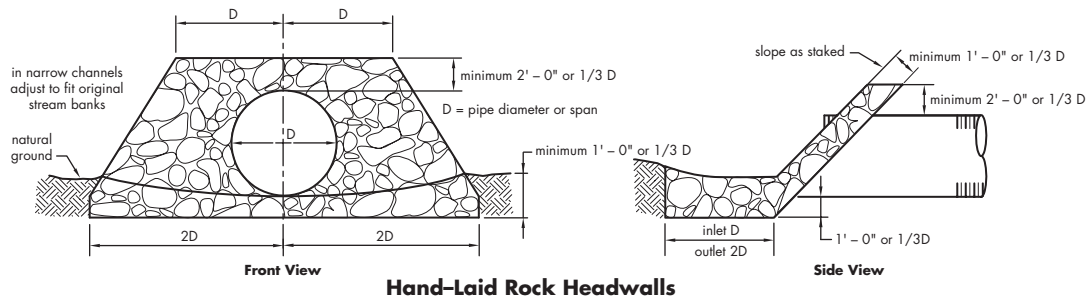
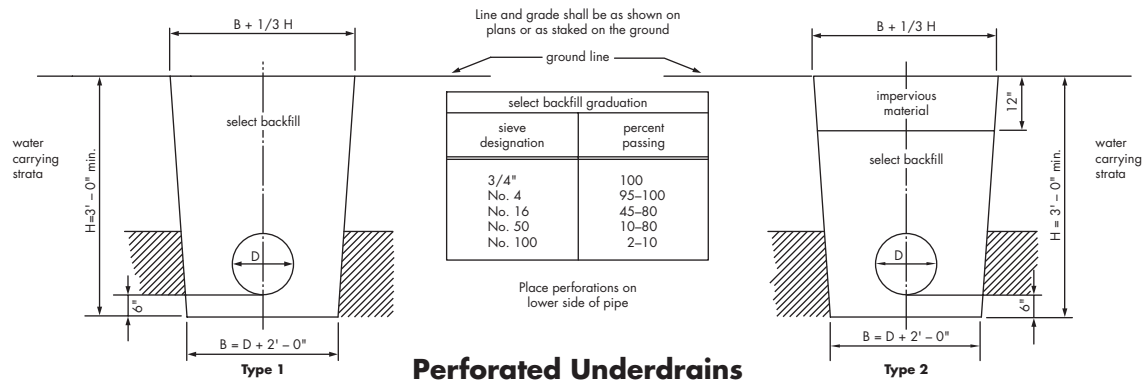
Excavation, bedding, and backfilling of culverts should be conducted according to requirements of the surface management agency and good engineering practices. Compliance with applicable Clean Water Act Best Management Practices and requirements for passage of aquatic species is required.

Ditch Relief Culverts

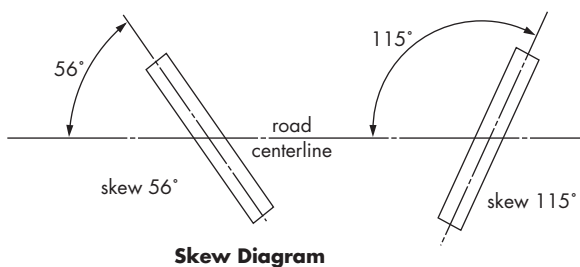
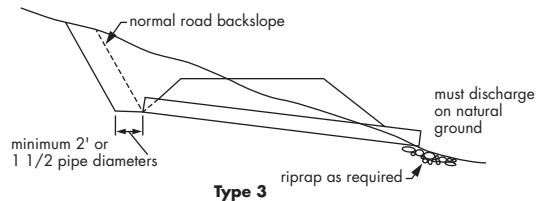
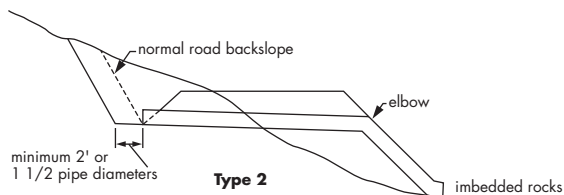
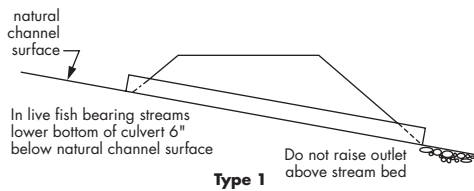
Ditch relief culverts are installed to periodically relieve the ditch line flow by piping water to the opposite side of the road where the flow can be dispersed away from the roadway. The spacing of ditch relief culverts (Figure 6) is dependent on the road gradient, soil types, and runoff characteristics.

A culvert with an 18-inch diameter is the minimum for ditch relief to prevent failure from debris blockage.

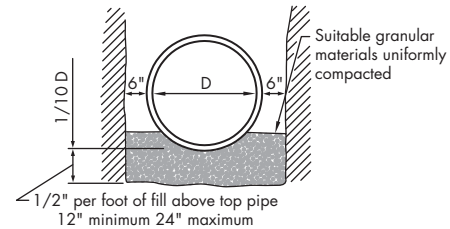
The depth of culvert burial must be sufficient to ensure protection of the culvert barrel for the design life of the culvert. This requires anticipating the amount of material that may be lost due to road use and erosion.



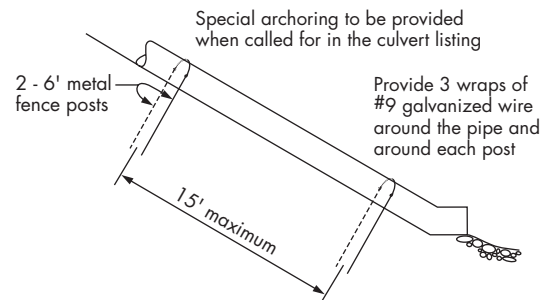
Culvert Construction Details



Typical Bedding Details



Rock Foundation



Special Anchoring Type 2 Downdrains

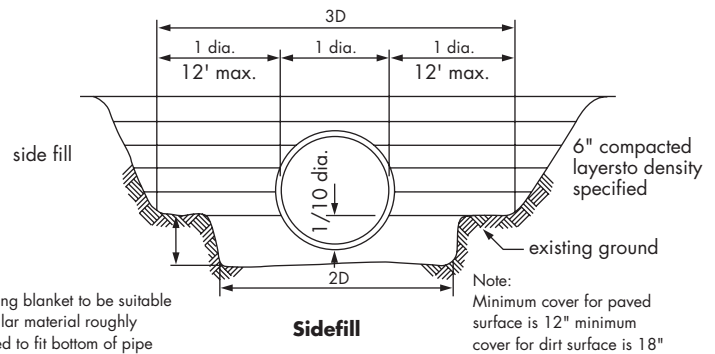


Figure 7. Diagrams for proper culvert installation

Ditch relief culverts can provide better flow when skewed with an entrance angle of 45 to 60 degrees with the side of the ditch. The culvert gradient should be greater than the approach ditch gradient. This improves the flow hydraulics and reduces siltation and debris plugging the culvert inlet. Culverts placed in natural drainages can also be used for ditch relief.

Bridges and Major Culverts

Federal Highway Administration (FHA) regulations and BLM and FS road manuals require that on roads open to public travel, all bridges and culverts that in combination span at least 20 feet horizontal distance, must comply with the National Bridge Inspection and Reporting Standards. Thus, BLM and FS manuals require that all such facilities have engineering approval from Regional or State offices. Operators are encouraged to prepare applications requiring major culverts or bridges to allow sufficient time for agency engineering evaluations. Construction of some stream crossings may require a Section 404 Corps of Engineers permit in addition to the approval of the surface management agency.

Wetland Crossings

Wetlands are especially sensitive areas and should be avoided, if possible. Generally, these areas require crossings that prevent unnatural fluctuations in water level. Marshy and swampy terrain may contain bodies of water with no discernible current. The design of culverts for roads crossing these locations requires unique considerations. Construction of some wetland crossings may require a Section 404 Corps of Engineers permit in addition to the approval of the surface management agency.

The culvert should be designed with a flat grade so water can flow either way and maintain its natural water level on both sides. The culvert may become partially blocked by aquatic growth

and should be installed with the flowline below the standing water level at its lowest elevation. Special attention must be given to the selection of culvert materials that will resist corrosion.

Low-Water Crossings

Roads may cross small drainages and intermittent streams where culverts and bridges are unnecessary. The crossing can be effectively accomplished by dipping the road down to the bed of the drainage. Site-specific designs and the construction of gravel, rip-rap, or concrete bottoms may be required in some situations. In no case should the drainage be filled so that water will be impounded. Low-water crossings that are not surfaced should not be used in wet conditions. Low-water crossings, in combination with culverts, may be utilized if the crossing is designed such that the structure is stable and self cleaning.

Subdrainage

If water is not removed from the subgrade or pavement structure, it may create instability, reduce load-bearing capacity, increase possible damage from frost action, and create a safety hazard by freezing on the road surface.

Perforated pipe drains and associated filter fabric or aggregate filters may be used when necessary to provide subdrainage. Other methods may be approved by the authorized officer.

Subdrainage systems may effectively reduce final road costs by decreasing the depth of base course needed, thereby reducing subgrade widths. This, in turn, results in less clearing and excavation. Maintenance savings may also be realized as the result of a more stable subgrade.

The solutions to subdrainage problems can be expensive. Road management techniques, such as reducing traffic loads or removing traffic until a subgrade dries out, may be considered as an alternative.

Pipelines and Flowlines

Construction

Steep hillsides and water courses should be avoided in the location of pipelines and flowlines. Flowline routes should take advantage of road corridors wherever possible to minimize surface disturbance and provide better leak detection and access for installation and repair operations. Consider maintenance needs and safety when burying power and pipelines in or immediately adjacent to the road.

When clearing is necessary, the width disturbed should be kept to a minimum. Topsoil material must be stockpiled to the side of the routes where cuts and fills or other surface disturbances occur during pipeline construction. Topsoil material must be segregated and not be mixed or covered with

subsurface material. Bladed materials must be placed back into the cleared route upon completion of construction and returned back to the original contour before reapplying topsoil.

Pipelines and flowlines should be tested for leaks before backfilling trenches. Pipeline trenches should be compacted during backfilling. After construction, cut-and-fill slopes must be regraded to conform to the adjacent terrain and reclaimed. Pipeline rights-of-way must be maintained in order to correct backfill settling and prevent erosion.

Pipeline construction should not block, dam, or change the natural course of any drainage. Suspended pipelines should provide adequate clearance for high-flow events, floating debris, wildlife, or livestock. Pipelines buried across stream crossings should be buried below the scouring depth.

Chapter 6 – Reclamation and Abandonment



Reclamation Objective

Oil and gas development is one of many uses of the public lands and resources. While development may have a short- or long-term effect on the land, successful reclamation can ensure the effect is not permanent. During the life of the development, all disturbed areas not needed for active support of production operations should undergo “interim” reclamation in order to minimize the environmental impacts of

development on other resources and uses. At final abandonment, well locations, production facilities, and access roads must undergo “final” reclamation so that the character and productivity of the land and water are restored.

Planning for reclamation **prior** to construction is critical to achieving successful reclamation in the future. Reclamation becomes significantly more difficult, more expensive, and less effective if sufficient topsoil is not salvaged, interim reclamation is not completed, and if proper care is not taken to construct pads and roads in locations that minimize reclamation needs.

The long-term objective of final reclamation is to set the course for eventual ecosystem restoration, including the restoration of the natural vegetation community, hydrology, and wildlife habitats. In most cases, this means returning the land to a condition approximating or equal to that which existed prior to the disturbance. The operator is generally not responsible for achieving full ecological restoration of the site. Instead, the operator must achieve the short-term stability, visual, hydrological, and productivity objectives of the surface management agency **and** take the steps necessary to ensure that long-term objectives will be reached through natural processes.

The reclamation process involves restoring the original landform or creating a landform that approximates and blends in with the surrounding landform. It also involves salvaging and reusing all available topsoil (whatever soil is on top) in a timely manner, revegetating disturbed areas to native species, controlling erosion, controlling invasive non-native plants and noxious weeds, and monitoring results. Reclamation measures should begin as soon as possible after the disturbance and continue until successful reclamation is achieved. With proper reclamation measures, over time, local native species will become re-established on the site and the area will regain its original productive and scenic potential.

Reclamation generally can be judged successful when a self-sustaining, vigorous, diverse, native (or otherwise approved) plant community is established on the site, with a density sufficient to control erosion and non-native plant invasion and to re-establish wildlife habitat or forage production. Erosion control is generally sufficient when adequate groundcover is reestablished, water naturally infiltrates into the soil, and gullying, headcutting, slumping, and deep or excessive rilling is not observed. The site must be free of State- or county-

listed noxious weeds, oil field debris, contaminated soil, and equipment. The operator should inform the surface management agency that reclamation has been completed and that the site is ready for final inspection when these requirements have been met.

Reclamation Plan

A reclamation plan is included in the Surface Use Plan of Operations and should discuss plans for both interim and final reclamation. Reclamation is required of any surface previously disturbed that is not necessary for continued production operations. The operator should submit a new plan with the Notice of Intent to Abandon (NIA) or Subsequent Report Plug and Abandon (SRA) using the Sundry Notices and Reports on Wells Form 3160-5 when abandoning wells and other facilities that do not have an approved reclamation plan. The BLM will forward the request to the FS or other surface management agency as appropriate. Additional reclamation measures may be required based on the conditions existing at the time of abandonment and made a part of the conditions of approval of the NIA or SRA. Earthwork for interim and final reclamation generally must be completed within 6 months of well completion or plugging (weather permitting). The following information includes components of the reclamation plan.

Plugging the Well

Well abandonment operations may not be started without the prior approval of the *Sundry Notices and Reports on Wells, Form 3160-5*, by the authorized officer. The Sundry Notice serves as the operator's NIA. In the case of newly drilled dry holes, failures, and emergency situations, oral approval may be obtained from the authorized officer subject to written confirmation by application. The operator must contact the BLM prior to plugging a well to allow for approval and witnessing of the plugging operations.

Pit Reclamation

All pits must be reclaimed to a natural condition that blends with the rest of the reclaimed pad area. In addition, the reclaimed pit must be restored to a safe and stable condition. In most cases, if it was necessary to line the pit with a synthetic liner, the

pit should not be trenched (cut) or filled (squeezed) while still containing fluids. Pits must be free of oil and other liquid and solid wastes, allowed to dry, be pumped dry, or solidified in-situ prior to filling. The pit liner must be removed to the solids level or treated to prevent its reemergence to the surface or its interference with long-term successful revegetation. If necessary, the pit area should usually be mounded slightly or restored to the original contour to allow for settling and positive surface drainage.

The concentration of nonexempt hazardous substances in the reserve pit at the time of pit backfilling must not exceed the standards set forth in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), PL 99-499. All oil and gas drilling-related CERCLA hazardous substances removed from a location and not reused at another drilling location must be disposed of in accordance with applicable Federal and State regulations. {(Refer to 42 USC 9601(14)(Definition of "hazardous substances"); 42 USC 6921(2)(A)(exclusion of certain wastes associated with exploration and production); EPA 530-95-003, Crude Oil and Natural Gas Exploration and Production Wastes: Exemption from RCRA Subtitle C Regulation (May 1995)}.

Site Preparation and Revegetation

Disturbed areas should be revegetated after the site has been satisfactorily prepared. Site preparation will include respreading topsoil to an adequate depth, and may also include ripping, tilling, disking on contour, and dozer track-imprinting. The operator will usually be advised of the revegetation methods, objectives, and seasons to plant, unless this information is included in the Application for Permit to Drill (APD) reclamation plan. Native perennial species or other plant materials specified by the surface management agency or private surface owner will be used. Seeding should be accomplished by drilling on the contour whenever practical or by other approved methods such as dozer track-walking followed by broadcast seeding. Seeding or planting should be repeated until revegetation is successful, as determined by the surface management agency.

When conditions are not favorable for the establishment of vegetation, such as periods of drought or the lack of sufficient salvaged topsoil, the surface management agency may allow for subsequent reseeding to be delayed until soil moisture conditions become favorable or may require additional cultural techniques such as mulching, fertilizing, fencing, or other practices. It is the operator's responsibility to monitor the site, take the necessary steps to ensure reclamation success, and to notify the surface management agency when success is achieved.

Reclamation is most effective when the ecology of the site is considered. The previous plant community or potential plant community native to the site should be identified to help determine the plant communities that can exist on the reclaimed site. Revegetation efforts will be hampered and costs increased if the site contains conditions detrimental to revegetation, such as heavy grazing pressure, insufficient salvaged topsoil, erosion, and compacted or contaminated soil. (Refer to Figure 1 for enclosure fence standards.)

Additional Guidelines

Supplemental guidelines and methods may be available that reflect local site and geographic conditions. These guidelines or methods may be obtained from the local surface management agency. Technical advances in reclamation practices are continually being developed that may be successfully applied to lands affected by oil and gas development.

Pipeline and Flowline Reclamation

Pipeline routes and roads should be co-located as much as possible to reduce reclamation needs and impacts to other resources. Pipeline trenches are to be compacted during backfilling and must be maintained to correct backfill settling and prevent erosion. Reclamation involves placing fill in the trench, compacting the fill, regrading cut-and-fill slopes to restore the original contour, replacing topsoil, installing temporary waterbars only where necessary to control erosion, and revegetating in accordance with a reclamation plan. Waterbars and

other erosion control devices must be maintained and repaired as necessary.

Following successful revegetation, surviving waterbars must be flattened to blend with the slope and then revegetated. If berms of topsoil were originally placed over the trench to accommodate settling, the surviving berms should also be flattened to blend with the surrounding landform and revegetated.

Final abandonment of pipelines and flowlines will involve flushing and properly disposing of any fluids in the lines. All surface lines and any lines that are buried close to the surface that may become exposed due to water or wind erosion, soil movement, or anticipated subsequent use, must be removed. Deeply buried lines may remain in place unless otherwise directed by the authorized officer.

Well Site Reclamation

Well site reclamation includes both interim and final reclamation.

Interim Reclamation

Interim reclamation consists of minimizing the footprint of disturbance by reclaiming all portions of the well site not needed for production operations. The portions of the cleared well site not needed for operational and safety purposes are recontoured to a final or intermediate contour that blends with the surrounding topography as much as possible. Sufficient level area remains for setup of a workover rig and to park equipment. In some cases, rig anchors may need to be pulled and reset after recontouring to allow for maximum reclamation. Topsoil is respread over areas not needed for all-weather operations. When practical, the operator should respread topsoil over the entire location and revegetate to within a few feet of the production facilities, unless an all-weather, surfaced, access route or turnaround is needed. In order to inspect and operate the well or complete workover operations, it may be necessary to drive, park, and operate on restored, interim vegetation within the previously disturbed area. This is generally acceptable provided damage is repaired and reclaimed following use. Under some situations, such as the presence of moist, clay soils, the operator or surface management agency may prefer that

vegetation and topsoil be removed during workover operations and restored following operations to prevent soil compaction.

To reduce final reclamation costs; maintain healthy, biologically active topsoil; and to minimize habitat, visual, and forage loss during the life of the well, the salvaged topsoil should be spread over the area of interim reclamation, rather than stockpiled. Where the topography is flat and it is, therefore, unnecessary to recontour the well location at the time of final reclamation, the operator should set aside

sufficient topsoil for final reclamation of the small, unreclaimed area around the wellhead. Any topsoil pile set aside should be revegetated to prevent it from eroding and to help maintain its biological viability. On sloped ground, during final reclamation, the topsoil and interim vegetation must be restripped from portions of the site that are not at the original contour, the well pad recontoured, and the topsoil respread over the entire disturbed site to ensure successful revegetation.



During the start of well production, this well pad was recontoured, revegetated, and shaped to blend in with the surrounding natural forest openings. Well production facilities were constructed off-site and out of view.

Final Reclamation

Following well plugging, well sites that do not blend seamlessly with the surrounding landform (contour) should not be left in place, even if there has been successful regrowth of vegetation on the site. Revegetation alone does not constitute successful reclamation. Restoration of the original landform is

a key element in ensuring that the effects of oil and gas development are not permanent.

To achieve final reclamation of a recently drilled dry hole, the well site must be recontoured to original contour or a contour that blends with the surrounding landform, stockpiled topsoil redistributed, and the site revegetated. To achieve final

reclamation of a formerly producing well, all topsoil and vegetation must be restripped from all portions of the old well site that were not previously reshaped to blend with the surrounding contour. All disturbed areas are then recontoured back to the original contour or a contour that blends with the surrounding landform, topsoil is redistributed, and the site revegetated.

In recontouring areas that have been surfaced with gravel or similar materials, the material must be removed from the well location or buried deep in the recontoured cut to prevent possible surface exposure. All excavations and pits must be closed by

backfilling when they are dry and free of waste and graded to conform to the surrounding terrain.

Salvaged topsoil must be respread evenly over the surfaces to be revegetated. The topsoiled site should be prepared to provide a seedbed for reestablishment of desirable vegetation. Site preparation may include gouging, scarifying, dozer track-walking, mulching, fertilizing, seeding, and planting.

Water breaks and terracing should only be installed when absolutely necessary to prevent erosion of fill material and should be removed when the site is successfully revegetated and stabilized.



The well pad and access road are constructed to the minimum size necessary to safely conduct drilling and completion operations.



The well pad and access road have been recontoured back to the original contour, the topsoil respread, and the site revegetated.

Road Reclamation

Interim reclamation consists of reclaiming portions of the road not needed for vehicle travel. Wherever possible, cut slopes, fill slopes, and borrow ditches should be covered with topsoil and revegetated to restore habitat, forage, scenic resources, and to reduce soil erosion and maintenance costs.

At abandonment, roads must be reclaimed by the operator unless the surface management agency or surface owner requests that they be left unreclaimed.

Final reclamation includes recontouring the road back to the original contour, seeding, controlling noxious weeds, and may also include other techniques to improve reclamation success, such as ripping, scarifying, replacing topsoil, placing waterbars, pitting, mulching, redistributing woody debris, and barricading.

Seeds of native, perennial species or other plant materials specified by the surface management agency or surface owner must be used. If waterbars were used, they should be removed and seeded following successful revegetation.

Reclamation of Other Associated Facilities

Other facilities and areas of surface disturbance associated with Federal oil and gas lease development, including water impoundments, power lines, metering buildings, compression facilities, and tank batteries must be removed and reclaimed in accordance with the standards identified previously and with the requirements of the surface management agency or surface owner.

Water Well Conversion

In some instances, the surface management agency or private landowner may wish to acquire a well that has encountered usable fresh water. Refer to 43 CFR 3162.3-4(b). In those cases, the operator has no further abandonment responsibility if the private landowner or surface management agency accepts all liability for the final plugging and reclamation of the water well and wellsite. Documentation of liability release will be issued to the responsible party.

Inspection and Final Abandonment Approval

The operator must file a Subsequent Report Plug and Abandon (SRA) following the plugging of a well. A Final Abandonment Notice (FAN) must be filed upon completion of reclamation operations, which indicates that the site meets reclamation objectives and is ready for inspection. Upon receipt of the Final Abandonment Notice, the surface management agency will inspect the site to ensure reclamation is fully successful.

BLM must approve the Final Abandonment Notice, even when the surface is managed by another surface management agency. Final abandonment will not be approved by the BLM until the surface reclamation work required by the APD, Notice of Intent to Abandon, or Subsequent Report Plug and Abandon has been completed and the required reclamation is acceptable to the surface management agency. The operator is responsible for monitoring reclamation progress and taking the necessary actions to ensure success.

Release of Bonds

If the well and associated facilities are covered by an individual lease bond, the period of liability on that bond can be terminated once the final abandonment has been approved. The principal (operator or lessee) can request termination of the period of liability from the BLM State Office holding the bond. If the well is covered by a statewide or nationwide bond, termination of the period of liability of these bonds is not approved until final abandonment of all activities conducted under the bond have been approved. The operator may request termination of the bond on the Final Abandonment Notice.



Appendix D

BMP Manual

Stormwater BMP Manual

Chevron USA, Inc.

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Description

Surface roughening is an erosion control practice that involves tracking, scarifying, imprinting, or tilling a disturbed area to provide temporary stabilization of disturbed areas. Surface roughening creates variations in the soil surface that help to minimize wind and water erosion. Depending on the technique used, surface roughening may also help establish conditions favorable to establishment of vegetation.



Photograph SR-1. Surface roughening via imprinting for temporary stabilization.

Appropriate Uses

Surface roughening can be used to provide temporary stabilization of disturbed areas, such as when revegetation cannot be immediately established due to seasonal planting limitations. Surface roughening is not a stand-alone BMP, and should be used in conjunction with other erosion and sediment controls.

Surface roughening is often implemented in conjunction with grading and is typically performed using heavy construction equipment to track the surface. Be aware that tracking with heavy equipment will also compact soils, which is not desirable in areas that will be revegetated. Scarifying, tilling, or ripping are better surface roughening techniques in locations where revegetation is planned. Roughening is not effective in very sandy soils and cannot be effectively performed in rocky soil.

Design and Installation

Typical design details for surfacing roughening on steep and mild slopes are provided in Details SR-1 and SR-2, respectively.

Surface roughening should be performed either after final grading or to temporarily stabilize an area during active construction that may be inactive for a short time period. Surface roughening should create depressions 2 to 6 inches deep and approximately 6 inches apart. The surface of exposed soil can be roughened by a number of techniques and equipment. Horizontal grooves (running parallel to the contours of the land) can be made using tracks from equipment treads, stair-step grading, ripping, or tilling.

Fill slopes can be constructed with a roughened surface. Cut slopes that have been smooth graded can be roughened as a subsequent operation. Roughening should follow along the contours of the slope. The tracks left by truck mounted equipment working perpendicular to the contour can leave acceptable horizontal depressions; however, the equipment will also compact the soil.

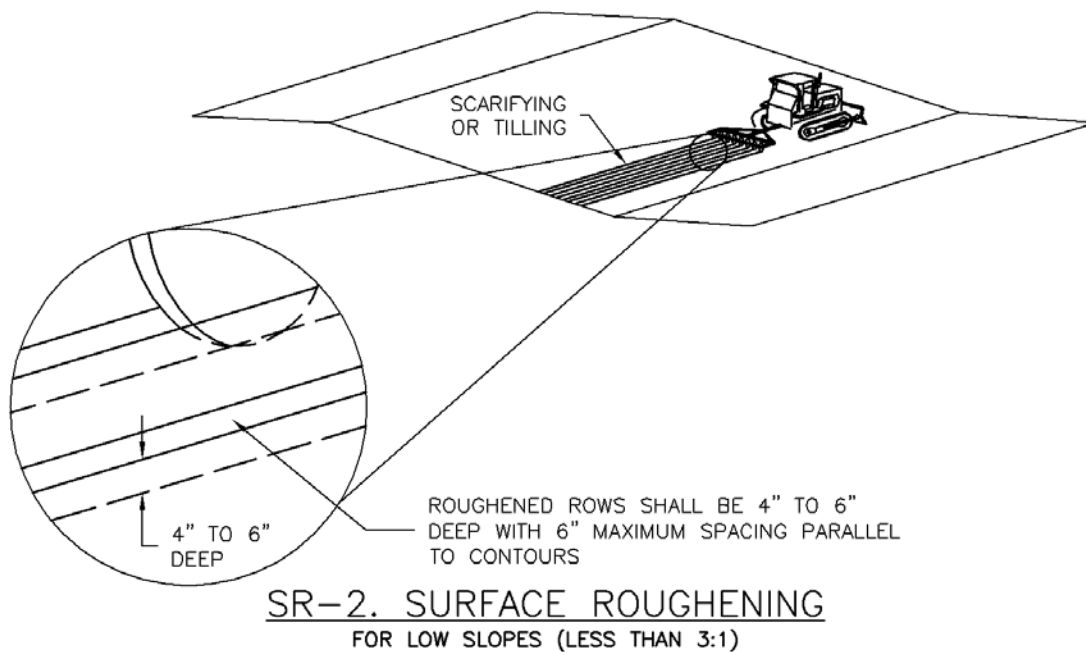
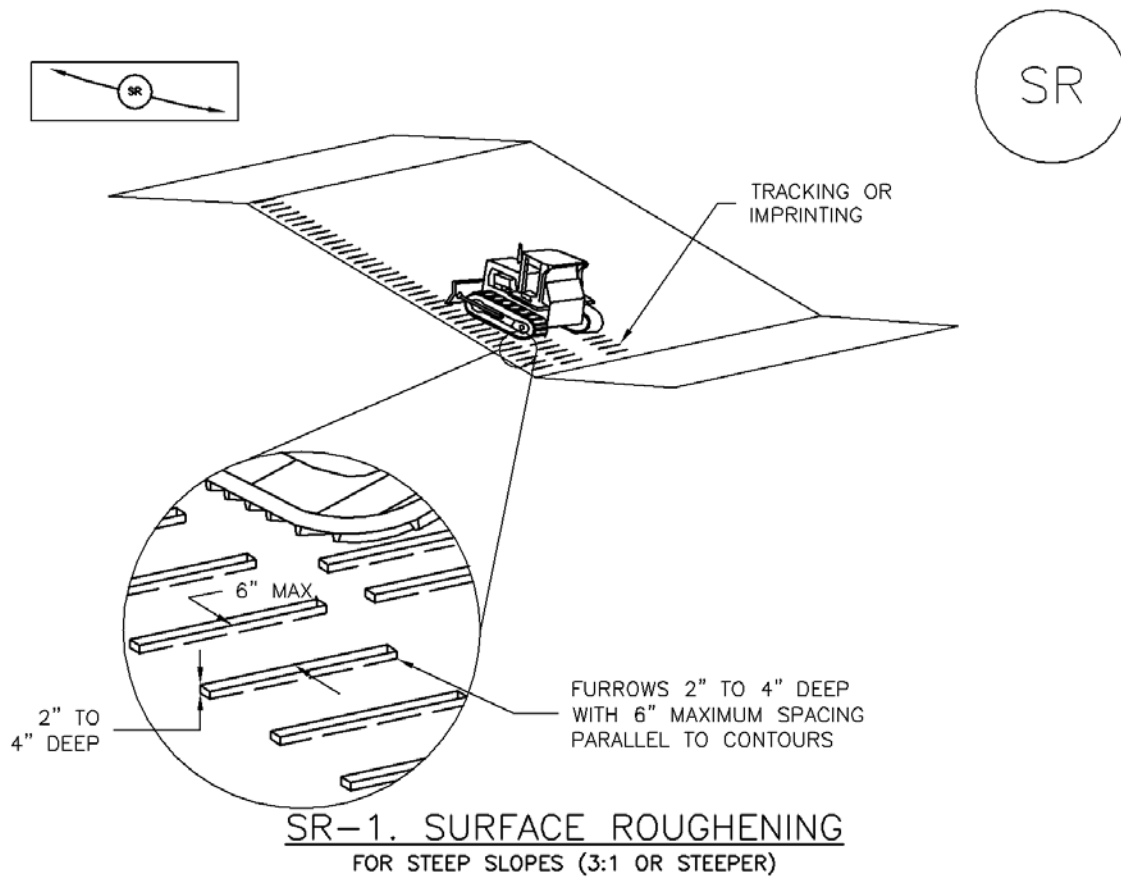
Surface Roughening	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

Maintenance and Removal

Care should be taken not to drive vehicles or equipment over areas that have been surface roughened. Tire tracks will smooth the roughened surface and may cause runoff to collect into rills and gullies.

Because surface roughening is only a temporary control, additional treatments may be necessary to maintain the soil surface in a roughened condition.

Areas should be inspected for signs of erosion. Surface roughening is a temporary measure, and will not provide long-term erosion control.



SURFACE ROUGHENING INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 –LOCATION(S) OF SURFACE ROUGHENING.
2. SURFACE ROUGHENING SHALL BE PROVIDED PROMPTLY AFTER COMPLETION OF FINISHED GRADING (FOR AREAS NOT RECEIVING TOPSOIL) OR PRIOR TO TOPSOIL PLACEMENT OR ANY FORECASTED RAIN EVENT.
3. AREAS WHERE BUILDING FOUNDATIONS, PAVEMENT, OR SOD WILL BE PLACED WITHOUT DELAY IN THE CONSTRUCTION SEQUENCE, SURFACE ROUGHENING IS NOT REQUIRED.
4. DISTURBED SURFACES SHALL BE ROUGHENED USING RIPPING OR TILLING EQUIPMENT ON THE CONTOUR OR TRACKING UP AND DOWN A SLOPE USING EQUIPMENT TREADS.
5. A FARMING DISK SHALL NOT BE USED FOR SURFACE ROUGHENING.

SURFACE ROUGHENING MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACE UPON DISCOVERY OF THE FAILURE.
4. VEHICLES AND EQUIPMENT SHALL NOT BE DRIVEN OVER AREAS THAT HAVE BEEN SURFACE ROUGHENED.
5. IN NON-TURF GRASS FINISHED AREAS, SEEDING AND MULCHING SHALL TAKE PLACE DIRECTLY OVER SURFACE ROUGHENED AREAS WITHOUT FIRST SMOOTHING OUT THE SURFACE.
6. IN AREAS NOT SEEDED AND MULCHED AFTER SURFACE ROUGHENING, SURFACES SHALL BE RE-ROUGHENED AS NECESSARY TO MAINTAIN GROOVE DEPTH AND SMOOTH OVER RILL EROSION.

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Temporary seeding can be used to stabilize disturbed areas that will be inactive for an extended period.

Permanent seeding should be used to stabilize areas at final grade that will not be otherwise stabilized. Effective seeding includes preparation of a seedbed, selection of an appropriate seed mixture, proper planting techniques, and protection of the seeded area with mulch, geotextiles, or other appropriate measures.



Photograph TS/PS -1. Equipment used to drill seed. Photo courtesy of Douglas County.

Appropriate Uses

When the soil surface is disturbed and will remain inactive for an extended period (typically 30 days or longer), proactive stabilization measures should be implemented. If the inactive period is short-lived (on the order of two weeks), techniques such as surface roughening may be appropriate. For longer periods of inactivity, temporary seeding and mulching can provide effective erosion control. Permanent seeding should be used on finished areas that have not been otherwise stabilized.

Typically, local governments have their own seed mixes and timelines for seeding. Check jurisdictional requirements for seeding and temporary stabilization.

Design and Installation

Effective seeding requires proper seedbed preparation, selection of an appropriate seed mixture, use of appropriate seeding equipment to ensure proper coverage and density, and protection with mulch or fabric until plants are established.

The USDCM Volume 2 *Revegetation* Chapter contains detailed seed mix, soil preparations, and seeding and mulching recommendations that may be referenced to supplement this Fact Sheet.

Drill seeding is the preferred seeding method. Hydroseeding is not recommended except in areas where steep slopes prevent use of drill seeding equipment, and even in these instances it is preferable to hand seed and mulch. Some jurisdictions do not allow hydroseeding or hydromulching.

Seedbed Preparation

Prior to seeding, ensure that areas to be revegetated have soil conditions capable of supporting vegetation. Overlot grading can result in loss of topsoil, resulting in poor quality subsoils at the ground surface that have low nutrient value, little organic matter content, few soil microorganisms, rooting restrictions, and conditions less conducive to infiltration of precipitation. As a result, it is typically necessary to provide stockpiled topsoil, compost, or other

Temporary and Permanent Seeding	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

EC-2 Temporary and Permanent Seeding (TS/PS)

soil amendments and rototill them into the soil to a depth of 6 inches or more.

Topsoil should be salvaged during grading operations for use and spread on areas to be revegetated later. Topsoil should be viewed as an important resource to be utilized for vegetation establishment, due to its water-holding capacity, structure, texture, organic matter content, biological activity, and nutrient content. The rooting depth of most native grasses in the semi-arid Denver metropolitan area is 6 to 18 inches. At a minimum, the upper 6 inches of topsoil should be stripped, stockpiled, and ultimately respread across areas that will be revegetated.

Where topsoil is not available, subsoils should be amended to provide an appropriate plant-growth medium. Organic matter, such as well digested compost, can be added to improve soil characteristics conducive to plant growth. Other treatments can be used to adjust soil pH conditions when needed. Soil testing, which is typically inexpensive, should be completed to determine and optimize the types and amounts of amendments that are required.

If the disturbed ground surface is compacted, rip or rototill the surface prior to placing topsoil. If adding compost to the existing soil surface, rototilling is necessary. Surface roughening will assist in placement of a stable topsoil layer on steeper slopes, and allow infiltration and root penetration to greater depth.

Prior to seeding, the soil surface should be rough and the seedbed should be firm, but neither too loose nor compacted. The upper layer of soil should be in a condition suitable for seeding at the proper depth and conducive to plant growth. Seed-to-soil contact is the key to good germination.

Seed Mix for Temporary Vegetation

To provide temporary vegetative cover on disturbed areas which will not be paved, built upon, or fully landscaped or worked for an extended period (typically 30 days or more), plant an annual grass appropriate for the time of planting and mulch the planted areas. Annual grasses suitable for the Denver metropolitan area are listed in Table TS/PS-1. These are to be considered only as general recommendations when specific design guidance for a particular site is not available. Local governments typically specify seed mixes appropriate for their jurisdiction.

Seed Mix for Permanent Revegetation

To provide vegetative cover on disturbed areas that have reached final grade, a perennial grass mix should be established. Permanent seeding should be performed promptly (typically within 14 days) after reaching final grade. Each site will have different characteristics and a landscape professional or the local jurisdiction should be contacted to determine the most suitable seed mix for a specific site. In lieu of a specific recommendation, one of the perennial grass mixes appropriate for site conditions and growth season listed in Table TS/PS-2 can be used. The pure live seed (PLS) rates of application recommended in these tables are considered to be absolute minimum rates for seed applied using proper drill-seeding equipment.

If desired for wildlife habitat or landscape diversity, shrubs such as rubber rabbitbrush (*Chrysothamnus nauseosus*), fourwing saltbush (*Atriplex canescens*) and skunkbrush sumac (*Rhus trilobata*) could be added to the upland seedmixes at 0.25, 0.5 and 1 pound PLS/acre, respectively. In riparian zones, planting root stock of such species as American plum (*Prunus americana*), woods rose (*Rosa woodsii*), plains cottonwood (*Populus sargentii*), and willow (*Populus spp.*) may be considered. On non-topsoiled upland sites, a legume such as Ladak alfalfa at 1 pound PLS/acre can be included as a source of nitrogen for perennial grasses.

Seeding dates for the highest success probability of perennial species along the Front Range are generally in the spring from April through early May and in the fall after the first of September until the ground freezes. If the area is irrigated, seeding may occur in summer months, as well. See Table TS/PS-3 for appropriate seeding dates.

Table TS/PS-1. Minimum Drill Seeding Rates for Various Temporary Annual Grasses

Species ^a (Common name)	Growth Season ^b	Pounds of Pure Live Seed (PLS)/acre ^c	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	½
5. Millet	Warm	3 - 15	½ - ¾
6. Sudangrass	Warm	5-10	½ - ¾
7. Sorghum	Warm	5-10	½ - ¾
8. Winter wheat	Cool	20-35	1 - 2
9. Winter barley	Cool	20-35	1 - 2
10. Winter rye	Cool	20-35	1 - 2
11. Triticale	Cool	25-40	1 - 2
<p>^a Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or mowed closer than 8 inches.</p> <p>Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching should be applied as a separate operation, when practical, to prevent the seeds from being encapsulated in the mulch.</p> <p>^b See Table TS/PS-3 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months.</p> <p>^c Seeding rates should be doubled if seed is broadcast, or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.</p>			

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Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses

Common ^a Name	Botanical Name	Growth Season ^b	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Alakali Soil Seed Mix					
Alkali sacaton	<i>Sporobolus airoides</i>	Cool	Bunch	1,750,000	0.25
Basin wildrye	<i>Elymus cinereus</i>	Cool	Bunch	165,000	2.5
Sodar streambank wheatgrass	<i>Agropyron riparium 'Sodar'</i>	Cool	Sod	170,000	2.5
Jose tall wheatgrass	<i>Agropyron elongatum 'Jose'</i>	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	<i>Agropyron smithii 'Arriba'</i>	Cool	Sod	110,000	5.5
Total					17.75
Fertile Loamy Soil Seed Mix					
Ephriam crested wheatgrass	<i>Agropyron cristatum 'Ephriam'</i>	Cool	Sod	175,000	2.0
Dural hard fescue	<i>Festuca ovina 'duriuscula'</i>	Cool	Bunch	565,000	1.0
Lincoln smooth brome	<i>Bromus inermis leyss 'Lincoln'</i>	Cool	Sod	130,000	3.0
Sodar streambank wheatgrass	<i>Agropyron riparium 'Sodar'</i>	Cool	Sod	170,000	2.5
Arriba western wheatgrass	<i>Agropyron smithii 'Arriba'</i>	Cool	Sod	110,000	7.0
Total					15.5
High Water Table Soil Seed Mix					
Meadow foxtail	<i>Alopecurus pratensis</i>	Cool	Sod	900,000	0.5
Redtop	<i>Agrostis alba</i>	Warm	Open sod	5,000,000	0.25
Reed canarygrass	<i>Phalaris arundinacea</i>	Cool	Sod	68,000	0.5
Lincoln smooth brome	<i>Bromus inermis leyss 'Lincoln'</i>	Cool	Sod	130,000	3.0
Pathfinder switchgrass	<i>Panicum virgatum 'Pathfinder'</i>	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	<i>Agropyron elongatum 'Alkar'</i>	Cool	Bunch	79,000	5.5
Total					10.75
Transition Turf Seed Mix^c					
Ruebens Canadian bluegrass	<i>Poa compressa 'Ruebens'</i>	Cool	Sod	2,500,000	0.5
Dural hard fescue	<i>Festuca ovina 'duriuscula'</i>	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	<i>Lolium perenne 'Citation'</i>	Cool	Sod	247,000	3.0
Lincoln smooth brome	<i>Bromus inermis leyss 'Lincoln'</i>	Cool	Sod	130,000	3.0
Total					7.5

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses (cont.)

Common Name	Botanical Name	Growth Season ^b	Growth Form	Seeds/ Pound	Pounds of PLS/acre
Sandy Soil Seed Mix					
Blue grama	<i>Bouteloua gracilis</i>	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	<i>Schizachyrium scoparium</i> 'Camper'	Warm	Bunch	240,000	1.0
Prairie sandreed	<i>Calamovilfa longifolia</i>	Warm	Open sod	274,000	1.0
Sand dropseed	<i>Sporobolus cryptandrus</i>	Cool	Bunch	5,298,000	0.25
Vaughn sideoats grama	<i>Bouteloua curtipendula</i> 'Vaughn'	Warm	Sod	191,000	2.0
Arriba western wheatgrass	<i>Agropyron smithii</i> 'Arriba'	Cool	Sod	110,000	5.5
Total					10.25
Heavy Clay, Rocky Foothill Seed Mix					
Ephriam crested wheatgrass ^d	<i>Agropyron cristatum</i> 'Ephriam'	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	<i>Agropyron intermedium</i> 'Oahe'	Cool	Sod	115,000	5.5
Vaughn sideoats grama ^e	<i>Bouteloua curtipendula</i> 'Vaughn'	Warm	Sod	191,000	2.0
Lincoln smooth brome	<i>Bromus inermis</i> leyss 'Lincoln'	Cool	Sod	130,000	3.0
Arriba western wheatgrass	<i>Agropyron smithii</i> 'Arriba'	Cool	Sod	110,000	5.5
Total					17.5
^a All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation. ^b See Table TS/PS-3 for seeding dates. ^c If site is to be irrigated, the transition turf seed rates should be doubled. ^d Crested wheatgrass should not be used on slopes steeper than 6H to 1V. ^e Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sideoats grama.					

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Table TS/PS-3. Seeding Dates for Annual and Perennial Grasses

Seeding Dates	Annual Grasses (Numbers in table reference species in Table TS/PS-1)		Perennial Grasses	
	Warm	Cool	Warm	Cool
January 1–March 15			✓	✓
March 16–April 30	4	1,2,3	✓	✓
May 1–May 15	4		✓	
May 16–June 30	4,5,6,7			
July 1–July 15	5,6,7			
July 16–August 31				
September 1–September 30		8,9,10,11		
October 1–December 31			✓	✓

Mulch

Cover seeded areas with mulch or an appropriate rolled erosion control product to promote establishment of vegetation. Anchor mulch by crimping, netting or use of a non-toxic tackifier. See the Mulching BMP Fact Sheet for additional guidance.

Maintenance and Removal

Monitor and observe seeded areas to identify areas of poor growth or areas that fail to germinate. Reseed and mulch these areas, as needed.

An area that has been permanently seeded should have a good stand of vegetation within one growing season if irrigated and within three growing seasons without irrigation in Colorado. Reseed portions of the site that fail to germinate or remain bare after the first growing season.

Seeded areas may require irrigation, particularly during extended dry periods. Targeted weed control may also be necessary.

Protect seeded areas from construction equipment and vehicle access.

Description

Soil binders include a broad range of treatments that can be applied to exposed soils for temporary stabilization to reduce wind and water erosion. Soil binders may be applied alone or as tackifiers in conjunction with mulching and seeding applications.

Acknowledgement: This BMP Fact Sheet has been adapted from the 2003 California Stormwater Quality Association (CASQA) Stormwater BMP Handbook: Construction (www.cabmphandbooks.com).



Photograph SB-1. Tackifier being applied to provide temporary soil stabilization. Photo courtesy of Douglas County.

Appropriate Uses

Soil binders can be used for short-term, temporary stabilization of soils on both mild and steep slopes. Soil binders are often used in areas where work has temporarily stopped, but is expected to resume before revegetation can become established. Binders are also useful on stockpiled soils or where temporary or permanent seeding has occurred.

Prior to selecting a soil binder, check with the state and local jurisdiction to ensure that the chemicals used in the soil binders are allowed. The water quality impacts of some types of soil binders are relatively unknown and may not be allowed due to concerns about potential environmental impacts. Soil binders must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces.

Soil binders should not be used in vehicle or pedestrian high traffic areas, due to loss in effectiveness under these conditions.

Site soil type will dictate appropriate soil binders to be used. Be aware that soil binders may not function effectively on silt or clay soils or highly compacted areas. Check manufacturer's recommendations for appropriateness with regard to soil conditions. Some binders may not be suitable for areas with existing vegetation.

Design and Installation

Properties of common soil binders used for erosion control are provided in Table SB-1. Design and installation guidance below are provided for general reference. Follow the manufacturer's instructions for application rates and procedures.

Soil Binders	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	Moderate

Table SB-1. Properties of Soil Binders for Erosion Control (Source: CASQA 2003)

Evaluation Criteria	Binder Type			
	Plant Material Based (short lived)	Plant Material Based (long lived)	Polymeric Emulsion Blends	Cementitious-Based Binders
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies	Varies	Varies	4,000 to 12,000 lbs/acre Typ.

Factors to consider when selecting a soil binder generally include:

- **Suitability to situation:** Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor.
- **Soil types and surface materials:** Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- **Frequency of application:** The frequency of application can be affected by subgrade conditions, surface type, climate, and maintenance schedule. Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

An overview of major categories of soil binders, corresponding to the types included in Table SB-1 follows.

Plant-Material Based (Short Lived) Binders

- **Guar:** A non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lbs per 1,000 gallons. Recommended minimum application rates are provided in Table SB-2.

Table SB-2. Application Rates for Guar Soil Stabilizer

	Slope (H:V)				
	Flat	4:1	3:1	2:1	1:1
Application Rate (lb/acre)	40	45	50	60	70

- **Psyllium:** Composed of the finely ground muciloid coating of plantago seeds that is applied as a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lbs/acre, with enough water in solution to allow for a uniform slurry flow.
- **Starch:** Non-ionic, cold-water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

Plant-Material Based (Long Lived) Binders

- **Pitch and Rosin Emulsion:** Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48 percent. The rosin should be a minimum of 26 percent of the total solids content. The soil stabilizer should be a non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:
 - For clayey soil: 5 parts water to 1 part emulsion

- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

Polymeric Emulsion Blend Binders

- **Acrylic Copolymers and Polymers:** Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55 percent solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without inhibiting water infiltration, and should not re-emulsify when cured. The applied compound should air cure within a maximum of 36 to 48 hours. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.
- **Liquid Polymers of Methacrylates and Acrylates:** This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100 percent acrylic emulsion blend of 40 percent solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.
- **Copolymers of Sodium Acrylates and Acrylamides:** These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient, as summarized in Table SB-3.

Table SB-3. Application Rates for Copolymers of Sodium Acrylates and Acrylamides

	Slope (H:V)		
	Flat to 5:1	5:1 to 3:1	2:2 to 1:1
Application Rate (lb/acre)	3.0-5.0	5.0-10.0	10.0-20.0

- **Polyacrylamide and Copolymer of Acrylamide:** Linear copolymer polyacrylamide is packaged as a dry flowable solid. When used as a stand-alone stabilizer, it is diluted at a rate of 11 lb/1,000 gal. of water and applied at the rate of 5.0 lb/acre.
- **Hydrocolloid Polymers:** Hydrocolloid Polymers are various combinations of dry flowable polyacrylamides, copolymers, and hydrocolloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

Cementitious-Based Binders

- **Gypsum:** This formulated gypsum based product readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86 percent. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

Installation

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
 - Crown or slope ground to avoid ponding.
 - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd² or according to manufacturer's recommendations.
 - Apply solution under pressure. Overlap solution 6 to 12 in.
 - Allow treated area to cure for the time recommended by the manufacturer, typically at least 24 hours.
 - Apply second treatment before first treatment becomes ineffective, using 50 percent application rate.
 - In low humidity, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd².

Maintenance and Removal

Soil binders tend to break down due to natural weathering. Weathering rates depend on a variety of site-specific and product characteristics. Consult the manufacturer for recommended reapplication rates and reapply the selected soil binder as needed to maintain effectiveness.

Soil binders can fail after heavy rainfall events and may require reapplication. In particular, soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.

Areas where erosion is evident should be repaired and soil binder or other stabilization reapplied, as needed. Care should be exercised to minimize the damage to protected areas while making repairs.

Most binders biodegrade after exposure to sun, oxidation, heat and biological organisms; therefore, removal of the soil binder is not typically required.

Description

Mulching consists of evenly applying straw, hay, shredded wood mulch, rock, bark or compost to disturbed soils and securing the mulch by crimping, tackifiers, netting or other measures. Mulching helps reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff. Although often applied in conjunction with temporary or permanent seeding, it can also be used for temporary stabilization of areas that cannot be reseeded due to seasonal constraints.

Mulch can be applied either using standard mechanical dry application methods or using hydromulching equipment that hydraulically applies a slurry of water, wood fiber mulch, and often a tackifier.



Photograph MU-1. An area that was recently seeded, mulched, and crimped.

Appropriate Uses

Use mulch in conjunction with seeding to help protect the seedbed and stabilize the soil. Mulch can also be used as a temporary cover on low to mild slopes to help temporarily stabilize disturbed areas where growing season constraints prevent effective reseeded. Disturbed areas should be properly mulched and tacked, or seeded, mulched and tacked promptly after final grade is reached (typically within no longer than 14 days) on portions of the site not otherwise permanently stabilized.

Standard dry mulching is encouraged in most jurisdictions; however, hydromulching may not be allowed in certain jurisdictions or may not be allowed near waterways.

Do not apply mulch during windy conditions.

Design and Installation

Prior to mulching, surface-roughen areas by rolling with a crimping or punching type roller or by track walking. Track walking should only be used where other methods are impractical because track walking with heavy equipment typically compacts the soil.

A variety of mulches can be used effectively at construction sites. Consider the following:

Mulch	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

- Clean, weed-free and seed-free cereal grain straw should be applied evenly at a rate of 2 tons per acre and must be tacked or fastened by a method suitable for the condition of the site. Straw mulch must be anchored (and not merely placed) on the surface. This can be accomplished mechanically by crimping or with the aid of tackifiers or nets. Anchoring with a crimping implement is preferred, and is the recommended method for areas flatter than 3:1. Mechanical crimpers must be capable of tucking the long mulch fibers into the soil to a depth of 3 inches without cutting them. An agricultural disk, while not an ideal substitute, may work if the disk blades are dull or blunted and set vertically; however, the frame may have to be weighted to afford proper soil penetration.
- Grass hay may be used in place of straw; however, because hay is comprised of the entire plant including seed, mulching with hay may seed the site with non-native grass species which might in turn out-compete the native seed. Alternatively, native species of grass hay may be purchased, but can be difficult to find and are more expensive than straw. Purchasing and utilizing a certified weed-free straw is an easier and less costly mulching method. When using grass hay, follow the same guidelines as for straw (provided above).
- On small areas sheltered from the wind and heavy runoff, spraying a tackifier on the mulch is satisfactory for holding it in place. For steep slopes and special situations where greater control is needed, erosion control blankets anchored with stakes should be used instead of mulch.
- Hydraulic mulching consists of wood cellulose fibers mixed with water and a tackifying agent and should be applied at a rate of no less than 1,500 pounds per acre (1,425 lbs of fibers mixed with at least 75 lbs of tackifier) with a hydraulic mulcher. For steeper slopes, up to 2000 pounds per acre may be required for effective hydroseeding. Hydromulch typically requires up to 24 hours to dry; therefore, it should not be applied immediately prior to inclement weather. Application to roads, waterways and existing vegetation should be avoided.
- Erosion control mats, blankets, or nets are recommended to help stabilize steep slopes (generally 3:1 and steeper) and waterways. Depending on the product, these may be used alone or in conjunction with grass or straw mulch. Normally, use of these products will be restricted to relatively small areas. Biodegradable mats made of straw and jute, straw-coconut, coconut fiber, or excelsior can be used instead of mulch. (See the ECM/TRM BMP for more information.)
- Some tackifiers or binders may be used to anchor mulch. Check with the local jurisdiction for allowed tackifiers. Manufacturer's recommendations should be followed at all times. (See the Soil Binder BMP for more information on general types of tackifiers.)
- Rock can also be used as mulch. It provides protection of exposed soils to wind and water erosion and allows infiltration of precipitation. An aggregate base course can be spread on disturbed areas for temporary or permanent stabilization. The rock mulch layer should be thick enough to provide full coverage of exposed soil on the area it is applied.

Maintenance and Removal

After mulching, the bare ground surface should not be more than 10 percent exposed. Reapply mulch, as needed, to cover bare areas.

Description

A compost blanket is a layer of compost uniformly applied to the soil in disturbed areas to control erosion, facilitate revegetation, and retain sediment resulting from sheet-flow runoff.

A compost filter berm is a dike of compost or a compost product that is placed perpendicular to runoff to control erosion in disturbed areas and retain sediment. Compost berms can be placed at regular intervals to help reduce the formation of rill and gully erosion when a compost blanket is stabilizing a slope.

Appropriate Uses

Compost blankets can be used as an alternative to erosion control blankets and mulching to help stabilize disturbed areas where sheet flow conditions are present. Compost blankets should not be used in areas of concentrated flows. Compost provides an excellent source of nutrients for plant growth, and should be considered for use in areas that will be permanently vegetated.



Photograph CB-1. Application of a compost blanket to a disturbed area. Photo courtesy of Caltrans.

Design and Installation

See Detail CB-1 for design details and notes.

Do not place compost in areas where it can easily be transported into drainage pathways or waterways. When using a compost blanket on a slope, berms should be installed periodically to reduce the potential for concentrated flow and rilling. Seeding should be completed before an area is composted or incorporated into the compost.

Compost quality is an important consideration when selecting compost blankets or berms. Representative compost quality factors include pH, salinity, moisture content, organic matter content, stability (maturity), and physical contaminants. The compost should meet all local, state, and federal quality requirements. Biosolids compost must meet the Standards for Class A biosolids outlined in 40 CFR Part 503. The U.S. Composting Council (USCC) certifies compost products under its Seal of Testing Assurance (STA) Program. Compost producers whose products have been certified through the STA Program provide customers with a standard product label that allows comparison between compost products. Only STA certified, Class I compost should be used.

Compost Blankets and Berms	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

Maintenance and Removal

When rills or gullies develop in an area that has been composted, fill and cover the area with additional compost and install berms as necessary to help reduce erosion.

Weed control can be a maintenance challenge in areas using compost blankets. A weed control strategy may be necessary, including measures such as mechanical removal and spot application of targeted herbicides by licensed applicators.

For compost berms, accumulated sediments should be removed from behind the berm when the sediments reach approximately one third the height of the berm. Areas that have been washed away should be replaced. If the berm has experienced significant or repeated washouts, a compost berm may not be the appropriate BMP for this area.

Compost blankets and berms biodegrade and do not typically require removal following site stabilization.

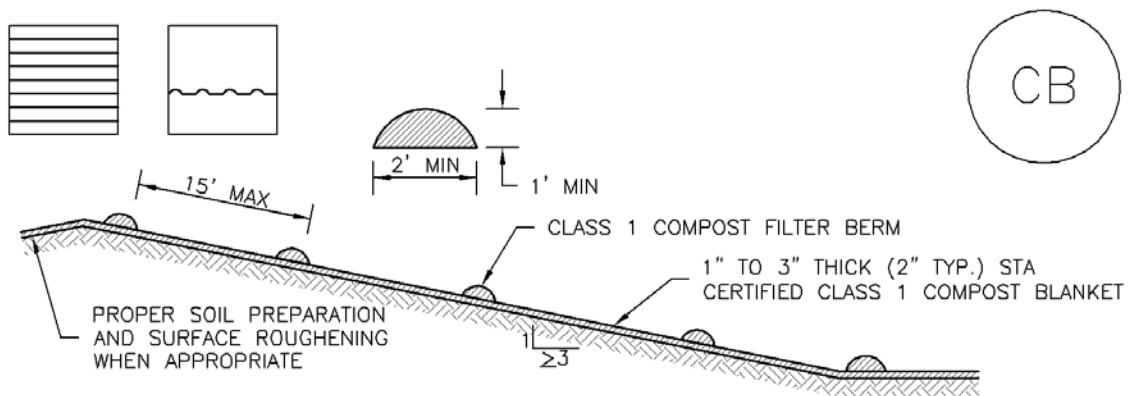


TABLE CB-1. CLASS 1 COMPOST	
PARAMETERS	CHARACTERISTIC
MINIMUM STABILITY INDICATOR	STABLE TO VERY STABLE
SOLUBLE SALTS	MAXIMUM 5 mmhos/cm
PH	6.0 – 8.0
AG INDEX	> 10
MATURITY INDICATOR EXPRESSED AS PERCENTAGE OF GERMINATION/VIGOR	80+/80+
MATURITY INDICATOR EXPRESSED AS AMMONIA N/ NITRATE N RATIO	< 4
MATURITY INDEX AS CARBON TO NITROGEN RATIO	20:1
TESTED FOR CLOPYRALID	YES/NEGATIVE RESULT
MOISTURE CONTENT	30–60%
ORGANIC MATTER CONTENT	25–45% OF DRY WEIGHT
PARTICLE SIZE DISTRIBUTION	3" (75mm) 100% PASSING
PRIMARY, SECONDARY NUTRIENTS; TRACE ELEMENTS	MUST BE REPORTED
TESTING AND TEST REPORT SUBMITTAL REQUIREMENTS	STA + CLOPYRALID
ORGANIC MATTER PER CUBIC YARD	MUST REPORT
CHEMICAL CONTAMINANTS	COMPLY WITH US EPA CLASS A STANDARD, 40 CFR 503.1 TABLES 1 & 3 LEVELS
MINIMUM MANUFACTURING/PRODUCTION REQUIREMENT	FULLY PERMITTED UNDER COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, HAZARDOUS MATERIALS AND WASTE MANAGEMENT DIVISION
RISK FACTOR RELATING TO PLANT GERMINATION AND HEALTH	LOW

CB-1. COMPOST BLANKET AND COMPOST FILTER BERM

COMPOST FILTER BERM AND COMPOST BLANKET INSTALLATION NOTES

1. SEE PLAN VIEW FOR
 - LOCATION OF COMPOST FILTER BERM(S).
 - LENGTH OF COMPOST FILTER BERM(S).
2. COMPOST BERMS AND BLANKETS MAY BE USED IN PLACE OF STRAW MULCH OR GEOTEXTILE FABRIC IN AREAS WHERE ACCESS TO LANDSCAPING IS DIFFICULT DUE TO LANDSCAPING OR OTHER OBJECTS OR IN AREAS WHERE A SMOOTH TURF GRASS FINISH IS DESIRED.
3. FILTER BERMS SHALL RUN PARALLEL TO THE CONTOUR.
4. FILTER BERMS SHALL BE A MINIMUM OF 1 FEET HIGH AND 2 FEET WIDE.
5. FILTER BERMS SHALL BE APPLIED BY PNEUMATIC BLOWER OR BY HAND.
6. FILTER BERMS SHALL ONLY BE UTILIZED IN AREAS WHERE SHEET FLOW CONDITIONS PREVAIL AND NOT IN AREAS OF CONCENTRATED FLOW.
7. COMPOST BLANKETS SHALL BE APPLIED AT A DEPTH OF 1 –3 INCHES (TYPICALLY 2 INCHES). FOR AREAS WITH EXISTING VEGETATION THAT ARE TO BE SUPPLEMENTED BY COMPOST, A THIN 0.5-INCH LAYER MAY BE USED.
8. SEEDING SHALL BE PERFORMED PRIOR TO THE APPLICATION OF COMPOST. ALTERNATIVELY, SEED MAY BE COMBINED WITH COMPOST AND BLOWN WITH THE PNEUMATIC BLOWER.
9. WHEN TURF GRASS FINISH IS NOT DESIRED, SURFACE ROUGHENING ON SLOPES SHALL TAKE PLACE PRIOR TO COMPOST APPLICATION.
10. COMPOST SHALL BE A CLASS 1 COMPOST AS DEFINED BY TABLE CB-1.

COMPOST FILTER BERM MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. COMPOST BERMS AND BLANKETS SHALL BE REAPPLIED OR REGRADED AS NECESSARY IF RILLING IN THE COMPOST SURFACE OCCURS.

(DETAILS ADAPTED FROM ARAPAHOE COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Rolled Erosion Control Products (RECPs) include a variety of temporary or permanently installed manufactured products designed to control erosion and enhance vegetation establishment and survivability, particularly on slopes and in channels. For applications where natural vegetation alone will provide sufficient permanent erosion protection, temporary products such as netting, open weave textiles and a variety of erosion control blankets (ECBs) made of biodegradable natural materials (e.g., straw, coconut fiber) can be used. For applications where natural vegetation alone will not be sustainable under expected flow conditions, permanent rolled erosion control products such as turf reinforcement mats (TRMs) can be used. In particular, turf reinforcement mats are designed for discharges that exert velocities and sheer stresses that exceed the typical limits of mature natural vegetation.



Photograph RECP-1. Erosion control blanket protecting the slope from erosion and providing favorable conditions for revegetation.

Appropriate Uses

RECPs can be used to control erosion in conjunction with revegetation efforts, providing seedbed protection from wind and water erosion. These products are often used on disturbed areas on steep slopes, in areas with highly erosive soils, or as part of drainageway stabilization. In order to select the appropriate RECP for site conditions, it is important to have a general understanding of the general types of these products, their expected longevity, and general characteristics.

The Erosion Control Technology Council (ECTC 2005) characterizes rolled erosion control products according to these categories:

- **Mulch control netting:** A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion control product to anchor loose fiber mulches.
- **Open weave textile:** A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.
- **Erosion control blanket (ECB):** A temporary degradable rolled erosion control product composed of processed natural or polymer fibers which are mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment. ECBs can be further differentiated into rapidly degrading single-net and double-net types or slowly degrading types.

Rolled Erosion Control Products	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

EC-6 Rolled Erosion Control Products (RECP)

- **Turf Reinforcement Mat (TRM):** A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh, and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.

Tables RECP-1 and RECP-2 provide guidelines for selecting rolled erosion control products appropriate to site conditions and desired longevity. Table RECP-1 is for conditions where natural vegetation alone will provide permanent erosion control, whereas Table RECP-2 is for conditions where vegetation alone will not be adequately stable to provide long-term erosion protection due to flow or other conditions.

Table RECP-1. ECTC Standard Specification for Temporary Rolled Erosion Control Products
(Adapted from Erosion Control Technology Council 2005)

Product Description	Slope Applications*		Channel Applications*	Minimum Tensile Strength ¹	Expected Longevity
	Maximum Gradient	C Factor ^{2,5}			
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft ² (12 Pa)	5 lbs/ft (0.073 kN/m)	Up to 12 months
Netless Rolled Erosion Control Blankets	4:1 (H:V)	≤0.10 @ 4:1	0.5 lbs/ft ² (24 Pa)	5 lbs/ft (0.073 kN/m)	
Single-net Erosion Control Blankets & Open Weave Textiles	3:1 (H:V)	≤0.15 @ 3:1	1.5 lbs/ft ² (72 Pa)	50 lbs/ft (0.73 kN/m)	
Double-net Erosion Control Blankets	2:1 (H:V)	≤0.20 @ 2:1	1.75 lbs/ft ² (84 Pa)	75 lbs/ft (1.09 kN/m)	
Mulch Control Nets	5:1 (H:V)	≤0.10 @ 5:1	0.25 lbs/ft ² (12 Pa)	25 lbs/ft (0.36 kN/m)	24 months
Erosion Control Blankets & Open Weave Textiles (slowly degrading)	1.5:1 (H:V)	≤0.25 @ 1.5:1	2.00 lbs/ft ² (96 Pa)	100 lbs/ft (1.45 kN/m)	24 months
Erosion Control Blankets & Open Weave Textiles	1:1 (H:V)	≤0.25 @ 1:1	2.25 lbs/ft ² (108 Pa)	125 lbs/ft (1.82 kN/m)	36 months

* C Factor and shear stress for mulch control nettings must be obtained with netting used in conjunction with pre-applied mulch material. (See Section 5.3 of Chapter 7 Construction BMPs for more information on the C Factor.)

¹ Minimum Average Roll Values, Machine direction using ECTC Mod. ASTM D 5035.

² C Factor calculated as ratio of soil loss from RECP protected slope (tested at specified or greater gradient, H:V) to ratio of soil loss from unprotected (control) plot in large-scale testing.

³ Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in) soil loss) during a 30-minute flow event in large-scale testing.

⁴ The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.01 - 0.05.

⁵ Acceptable large-scale test methods may include ASTM D 6459, or other independent testing deemed acceptable by the engineer.

⁶ Per the engineer's discretion. Recommended acceptable large-scale testing protocol may include ASTM D 6460, or other independent testing deemed acceptable by the engineer.

EC-6 Rolled Erosion Control Products (RECP)

Table RECP-2. ECTC Standard Specification for Permanent¹ Rolled Erosion Control Products
(Adapted from: Erosion Control Technology Council 2005)

Product Type	Slope Applications	Channel Applications	
TRMs with a minimum thickness of 0.25 inches (6.35 mm) per ASTM D 6525 and UV stability of 80% per ASTM D 4355 (500 hours exposure).	Maximum Gradient	Maximum Shear Stress ^{4,5}	Minimum Tensile Strength ^{2,3}
	0.5:1 (H:V)	6.0 lbs/ft ² (288 Pa)	125 lbs/ft (1.82 kN/m)
	0.5:1 (H:V)	8.0 lbs/ft ² (384 Pa)	150 lbs/ft (2.19 kN/m)
	0.5:1 (H:V)	10.0 lbs/ft ² (480 Pa)	175 lbs/ft (2.55 kN/m)

¹ For TRMs containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

² Minimum Average Roll Values, machine direction only for tensile strength determination using [ASTM D 6818](#) (Supersedes Mod. [ASTM D 5035](#) for RECPs)

³ Field conditions with high loading and/or high survivability requirements may warrant the use of a TRM with a tensile strength of 44 kN/m (3,000 lb/ft) or greater.

⁴ Required minimum shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in.) soil loss) during a 30-minute flow event in large scale testing.

⁵ Acceptable large-scale testing protocols may include [ASTM D 6460](#), or other independent testing deemed acceptable by the engineer.

Design and Installation

RECPs should be installed according to manufacturer's specifications and guidelines. Regardless of the type of product used, it is important to ensure no gaps or voids exist under the material and that all corners of the material are secured using stakes and trenching. Continuous contact between the product and the soil is necessary to avoid failure. Never use metal stakes to secure temporary erosion control products. Often wooden stakes are used to anchor RECPs; however, wood stakes may present installation and maintenance challenges and generally take a long time to biodegrade. Some local jurisdictions have had favorable experiences using biodegradable stakes.

This BMP Fact Sheet provides design details for several commonly used ECB applications, including:

ECB-1 Pipe Outlet to Drainageway

ECB-2 Small Ditch or Drainageway

ECB-3 Outside of Drainageway

Staking patterns are also provided in the design details according to these factors:

- ECB type
- Slope or channel type

For other types of RECPs including TRMs, these design details are intended to serve as general guidelines for design and installation; however, engineers should adhere to manufacturer's installation recommendations.

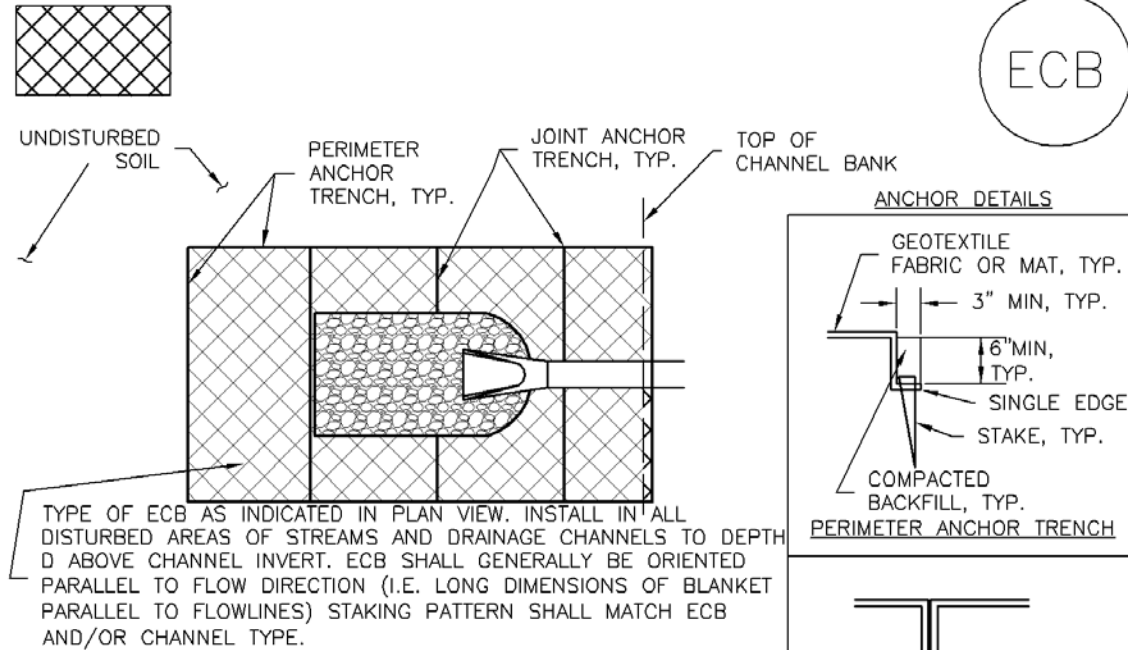
Maintenance and Removal

Inspection of erosion control blankets and other RECPs includes:

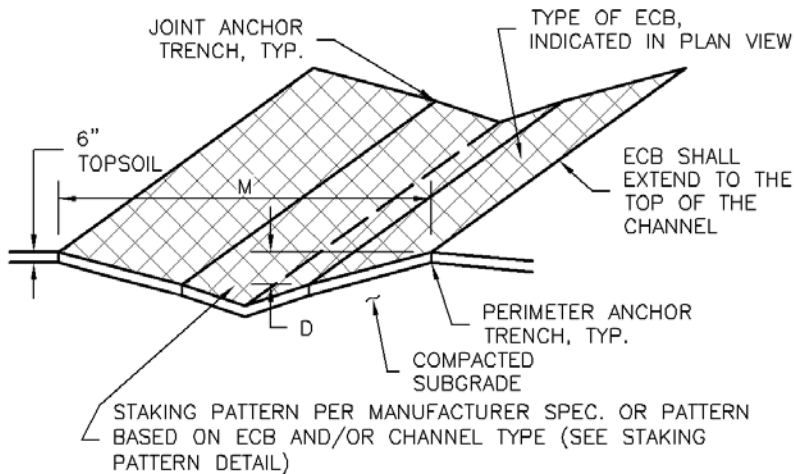
- Check for general signs of erosion, including voids beneath the mat. If voids are apparent, fill the void with suitable soil and replace the erosion control blanket, following the appropriate staking pattern.
- Check for damaged or loose stakes and secure loose portions of the blanket.

Erosion control blankets and other RECPs that are biodegradable typically do not need to be removed after construction. If they must be removed, then an alternate soil stabilization method should be installed promptly following removal.

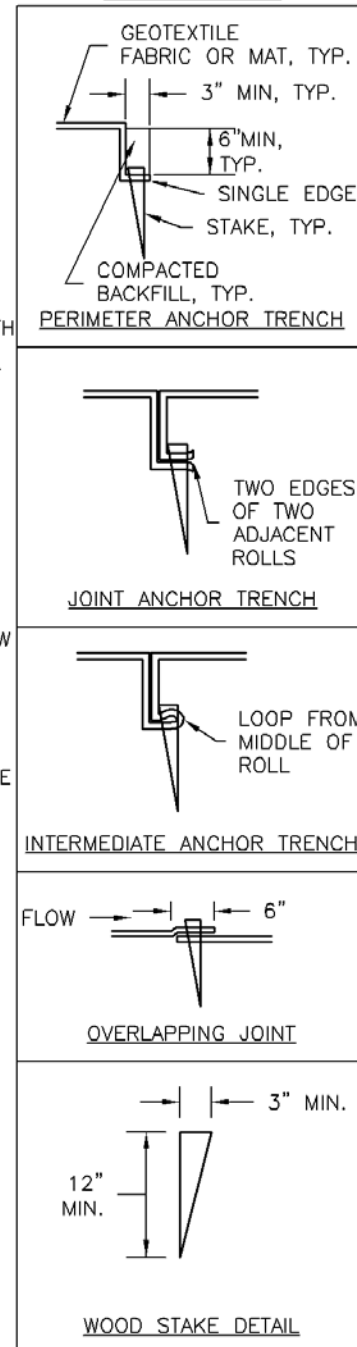
Turf reinforcement mats, although generally resistant to biodegradation, are typically left in place as a dense vegetated cover grows in through the mat matrix. The turf reinforcement mat provides long-term stability and helps the established vegetation resist erosive forces.

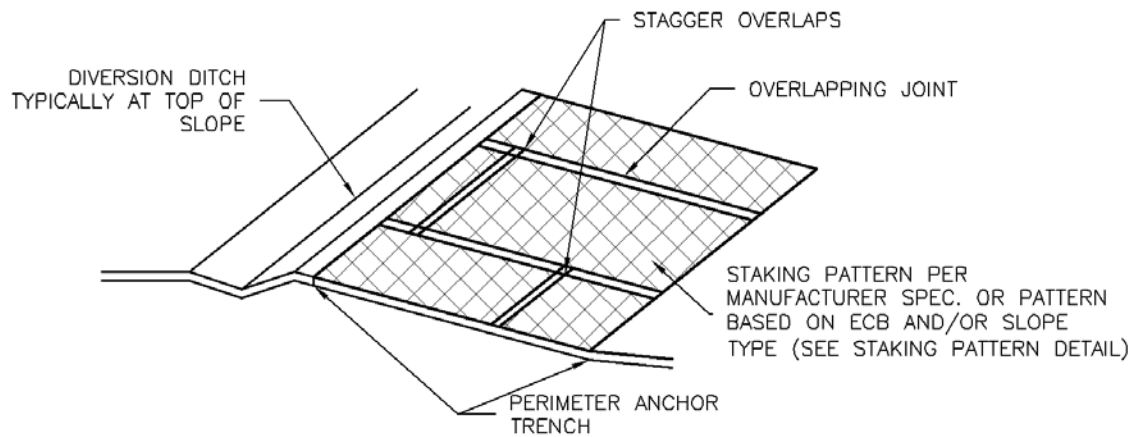


ECB-1. PIPE OUTLET TO DRAINAGEWAY

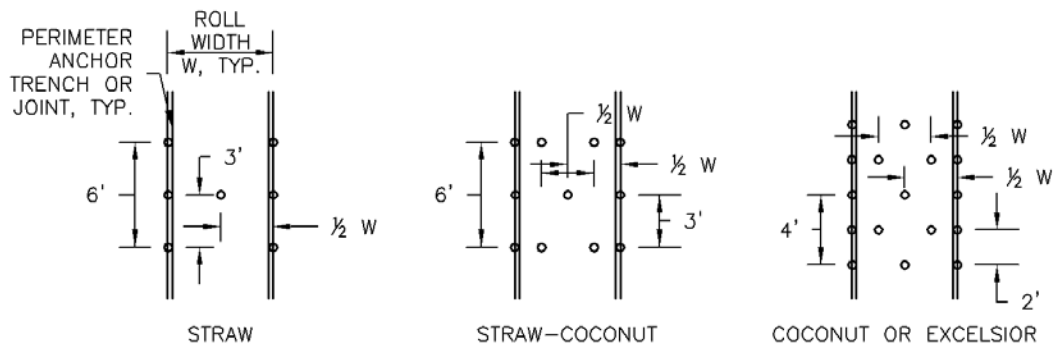


ECB-2. SMALL DITCH OR DRAINAGEWAY

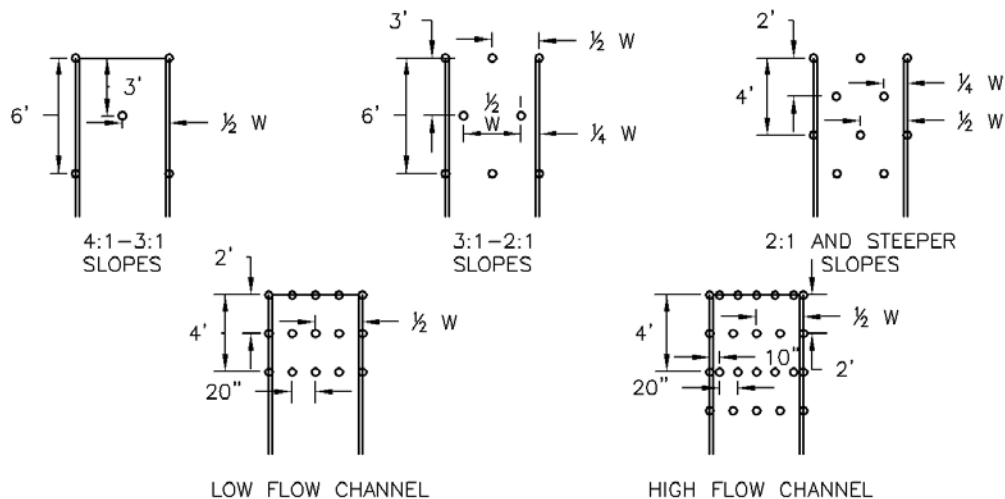




ECB-3. OUTSIDE OF DRAINAGEWAY



STAKING PATTERNS BY ECB TYPE



STAKING PATTERNS BY SLOPE OR CHANNEL TYPE

EC-6 Rolled Erosion Control Products (RECP)

EROSION CONTROL BLANKET INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATION OF ECB.
 - TYPE OF ECB (STRAW, STRAW-COCONUT, COCONUT, OR EXCELSIOR).
 - AREA, A, IN SQUARE YARDS OF EACH TYPE OF ECB.
2. 100% NATURAL AND BIODEGRADABLE MATERIALS ARE PREFERRED FOR RECPs, ALTHOUGH SOME JURISDICTIONS MAY ALLOW OTHER MATERIALS IN SOME APPLICATIONS.
3. IN AREAS WHERE ECBs ARE SHOWN ON THE PLANS, THE PERMITTEE SHALL PLACE TOPSOIL AND PERFORM FINAL GRADING, SURFACE PREPARATION, AND SEEDING AND MULCHING. SUBGRADE SHALL BE SMOOTH AND MOIST PRIOR TO ECB INSTALLATION AND THE ECB SHALL BE IN FULL CONTACT WITH SUBGRADE. NO GAPS OR VOIDS SHALL EXIST UNDER THE BLANKET.
4. PERIMETER ANCHOR TRENCH SHALL BE USED ALONG THE OUTSIDE PERIMETER OF ALL BLANKET AREAS.
5. JOINT ANCHOR TRENCH SHALL BE USED TO JOIN ROLLS OF ECBs TOGETHER (LONGITUDINALLY AND TRANSVERSELY) FOR ALL ECBs EXCEPT STRAW WHICH MAY USE AN OVERLAPPING JOINT.
6. INTERMEDIATE ANCHOR TRENCH SHALL BE USED AT SPACING OF ONE-HALF ROLL LENGTH FOR COCONUT AND EXCELSIOR ECBs.
7. OVERLAPPING JOINT DETAIL SHALL BE USED TO JOIN ROLLS OF ECBs TOGETHER FOR ECBs ON SLOPES.
8. MATERIAL SPECIFICATIONS OF ECBs SHALL CONFORM TO TABLE ECB-1.
9. ANY AREAS OF SEEDING AND MULCHING DISTURBED IN THE PROCESS OF INSTALLING ECBs SHALL BE RESEEDED AND MULCHED.
10. DETAILS ON DESIGN PLANS FOR MAJOR DRAINAGEWAY STABILIZATION WILL GOVERN IF DIFFERENT FROM THOSE SHOWN HERE.

TABLE ECB-1. ECB MATERIAL SPECIFICATIONS				
TYPE	COCONUT CONTENT	STRAW CONTENT	EXCELSIOR CONTENT	RECOMMENDED NETTING**
STRAW*	–	100%	–	DOUBLE/ NATURAL
STRAW- COCONUT	30% MIN	70% MAX	–	DOUBLE/ NATURAL
COCONUT	100%	–	–	DOUBLE/ NATURAL
EXCELSIOR	–	–	100%	DOUBLE/ NATURAL

*STRAW ECBs MAY ONLY BE USED OUTSIDE OF STREAMS AND DRAINAGE CHANNEL.

**ALTERNATE NETTING MAY BE ACCEPTABLE IN SOME JURISDICTIONS

EROSION CONTROL BLANKET MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. ECBs SHALL BE LEFT IN PLACE TO EVENTUALLY BIODEGRADE, UNLESS REQUESTED TO BE REMOVED BY THE LOCAL JURISDICTION.
5. ANY ECB PULLED OUT, TORN, OR OTHERWISE DAMAGED SHALL BE REPAIRED OR REINSTALLED. ANY SUBGRADE AREAS BELOW THE GEOTEXTILE THAT HAVE ERODED TO CREATED A VOID UNDER THE BLANKET, OR THAT REMAIN DEVOID OF GRASS SHALL BE REPAIRED, RESEDED AND MULCHED AND THE ECB REINSTALLED.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO AND TOWN OF PARKER COLORADO, NOT AVAILABLE IN AUTOCAD)

Description

A temporary slope drain is a pipe or culvert used to convey water down a slope where there is a high potential for erosion. A drainage channel or swale at the top of the slope typically directs upgradient runoff to the pipe entrance for conveyance down the slope. The pipe outlet must be equipped with outlet protection.



Photograph TSD-1. A temporary slope drain installed to convey runoff down a slope during construction. Photo courtesy of the City of Aurora.

Appropriate Uses

Use on long, steep slopes when there is a high potential of flow concentration or rill development.

Design and Installation

Effective use of temporary slope drains involves design of an effective collection system to direct flows to the pipe, proper sizing and anchoring of the pipe, and outlet protection. Upgradient of the temporary slope drain, a temporary drainage ditch or swale should be constructed to collect surface runoff from the drainage area and convey it to the drain entrance. The temporary slope drain must be sized to safely convey the desired flow volume. At a minimum, it should be sized to convey the 2-year, 24-hour storm.

Temporary slope drains may be constructed of flexible or rigid pipe, riprap, or heavy (30 mil) plastic lining. When piping is used, it must be properly anchored by burying it with adequate cover or by using an anchor system to secure it to the ground.

The discharge from the slope drain must be directed to a stabilized outlet, temporary or permanent channel, and/or sedimentation basin.

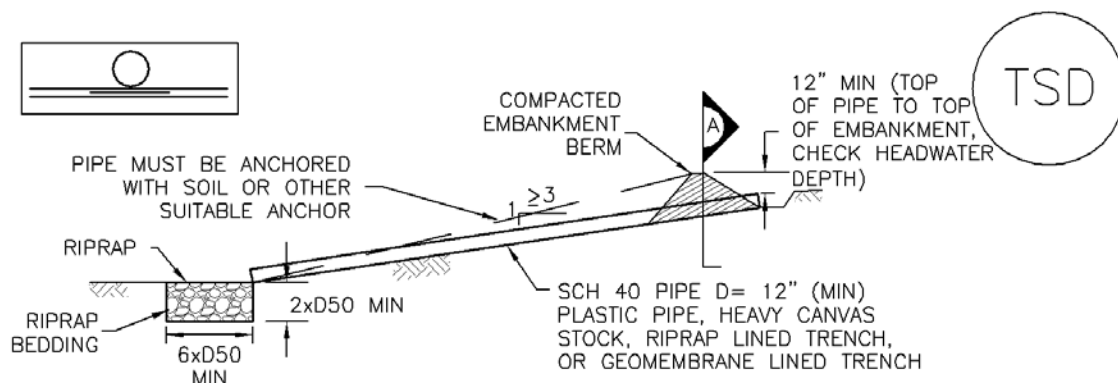
See Detail TSD-1 for additional sizing and design information.

Temporary Slope Drains	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

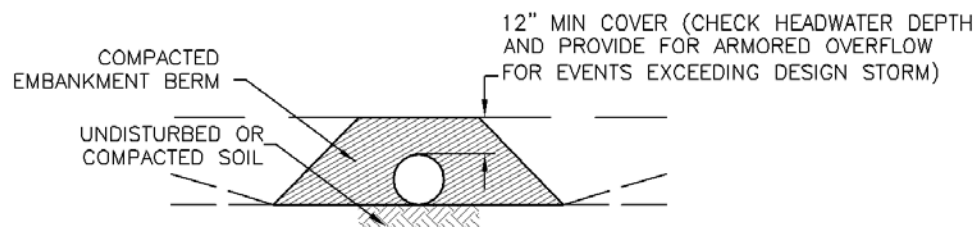
Maintenance and Removal

Inspect the entrance for sediment accumulation and remove, as needed. Clogging as a result of sediment deposition at the entrance can lead to ponding upstream causing flooding or overtopping of the slope drain. Inspect the downstream outlet for signs of erosion and stabilize, as needed. It may also be necessary to remove accumulated sediment at the outfall. Inspect pipe anchors to ensure that they are secure. If the pipe is secured by ground cover, ensure erosion has not compromised the depth of cover.

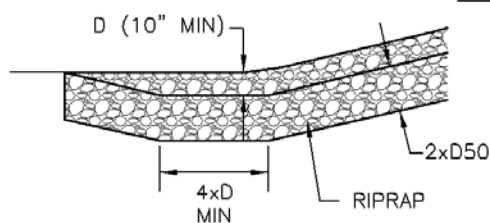
Slope drains should be removed when no longer needed or just prior to installation of permanent slope stabilization measures that cannot be installed with the slope drain in place. When slope drains are removed, the disturbed areas should be covered with topsoil, seeded, mulched or otherwise stabilized as required by the local jurisdiction.



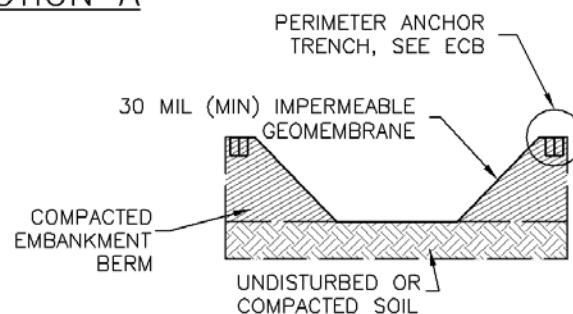
TEMPORARY SLOPE DRAIN PROFILE



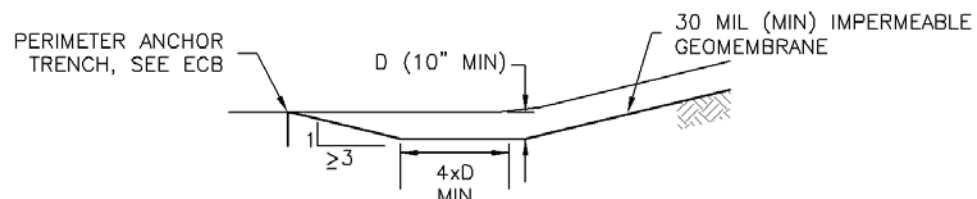
SECTION A



TERMINATION OF RIPRAP
LINED SLOPE DRAIN



GEOMEMBRANE LINED SLOPE DRAIN



TERMINATION OF GEOMEMBRANE LINED SLOPE DRAIN

TSD-1. TEMPORARY SLOPE DRAIN PROFILE

SLOPE DRAIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATION AND LENGTH OF SLOPE DRAIN
 - PIPE DIAMETER, D, AND RIPRAP SIZE, D50.
2. SLOPE DRAIN SHALL BE DESIGNED TO CONVEY PEAK RUNOFF FOR 2-YEAR 24-HOUR STORM AT A MINIMUM. FOR LONGER DURATION PROJECTS, LARGER MAY BE APPROPRIATE.
3. SLOPE DRAIN DIMENSIONS SHALL BE CONSIDERED MINIMUM DIMENSIONS; CONTRACTOR MAY ELECT TO INSTALL LARGER FACILITIES.
4. SLOPE DRAINS INDICATED SHALL BE INSTALLED PRIOR TO UPGRADIENT LAND-DISTURBING ACTIVITIES.
5. CHECK HEADWATER DEPTHS FOR TEMPORARY AND PERMANENT SLOPE DRAINS. DETAILS SHOW MINIMUM COVER; INCREASE AS NECESSARY FOR DESIGN HEADWATER DEPTH.
6. RIPRAP PAD SHALL BE PLACED AT SLOPE DRAIN OUTFALL.
7. ANCHOR PIPE BY COVERING WITH SOIL OR AN ALTERNATE SUITABLE ANCHOR MATERIAL.

SLOPE DRAIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. INSPECT INLET AND OUTLET POINTS AFTER STORMS FOR CLOGGING OR EVIDENCE OF OVERTOPPING. BREACHES IN PIPE OR OTHER CONVEYANCE SHALL BE REPAIRED AS SOON AS PRACTICABLE IF OBSERVED.
5. INSPECT RIPRAP PAD AT OUTLET FOR SIGNS OF EROSION. IF SIGNS OF EROSION EXIST, ADDITIONAL ARMORING SHALL BE INSTALLED.
6. TEMPORARY SLOPE DRAINS ARE TO REMAIN IN PLACE UNTIL NO LONGER NEEDED, BUT SHALL BE REMOVED PRIOR TO THE END OF CONSTRUCTION. WHEN SLOPE DRAINS ARE REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOP SOIL, SEEDED, MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF COLORADO SPRINGS, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



Description

A channel that is shaped or graded and protected with an erosion resistant rock riprap underlain with filter or bedding material used to convey stormwater runoff without allowing channel erosion. Rock channel protection provides for the safe conveyance of runoff from areas of concentrated flow without damage from erosion or flooding, where vegetated waterway / conveyance channel / swales would be inadequate. Rock lined channel may also be necessary to control seepage, piping, and sloughing or slides. The riprap section extends up the side slopes to designed depth. The earth above the rock should be vegetated or otherwise protected.

Conditions Where Practice Applies

This practice applies where the following conditions exist:

- Concentrated runoff will cause erosion unless a liner is provided
- Steep grades, wetness, seepage, prolonged base flow, or piping would cause erosion
- Damage by vehicles or animals will make the establishment or maintenance of vegetation difficult
- Soils are highly erosive or other soil or climatic conditions preclude the use of vegetation
- Velocities are expected that will erode the channel or outlet without protection

Caution should be used when design flow greater than 100 cubic feet per second (cfs) from a 10-yr.-frequency storm is expected. Chapter __ - Stream Channel Restoration, should be referenced for planning and design of larger channels.

Planning Considerations

Permits

A construction permit may be required by the local government. Additionally, the U.S. Army Corps of Engineers and the Ohio Environmental Protection Agency, through Sections 404 and 401, respectively, of the Clean Water Act, may require a permit for rock lined channel / outlet that are located adjacent to a stream. It is best to contact your local Soil and Water Conservation District (SWCD) office to determine what both agencies' permit requirements are for your project.

Water Quality

Rock lined channels and outlet protection provide water quality benefits by providing channel stability, prevention of excessive erosion, and limiting subsequent downstream sedimentation.

Design Criteria

Runoff

Runoff computation will be based upon the most severe soil and cover conditions that will exist in the area draining into the channel during the planned life of the structure. Use the NRCS Technical Release 55 (TR 55) or other suitable method shall be used to determine peak rate of runoff.

Capacity

The design capacity of the rock lined channel shall be adequate to carry the peak rate of runoff from a 10-yr. frequency storm. Where high-hazard conditions exist, higher frequency storms should be chosen to provide protection compatible with conditions. The rock-lined channel must have design capacity as required if it to be used as an outlet for a grassed waterway, diversion, terrace, or other measure. Capacity shall be computed using Manning's Equation with a coefficient of roughness "n" listed in the "rock size" table below.

Rock-lined channels / outlets shall be designed by accepted engineering methods such as the Federal Highway Administration Circular No. 15 or Figure 2-1 (Maximum depth of Flow for Riprap Lined Channels) that can be used to determine rock size using flow depth and velocity obtained from Manning's equation. Procedures are also available in the NRCS Engineering Field Handbook.

Velocity

Table 4.3.1 Maximum Design Velocity

Design Flow Depth	Maximum Velocity
0 - 0.5 ft	25 fps
0.5 - 1.0 ft	15 fps
> 1.0 ft	10 fps

Cross Section Shape

The cross sectional shape of rock lined waterway / outlets shall be parabolic, trapezoidal, or triangular.

- *Parabolic channels* most closely approximate natural flow characteristics at low as well as high flows. Although generally preferred for esthetic reasons, design and construction procedures are more complex.
- *Trapezoidal channels* often are used where the quantity of water to be carried is large and velocities high. The steepest permissible side slopes, horizontal to vertical, shall be 2 to 1.
- *Triangular shaped channels* generally is used where the quantity of water to be handled is relatively small, such as roadside ditches. The steepest permissible side slopes, horizontal to vertical, shall be 2 to 1.

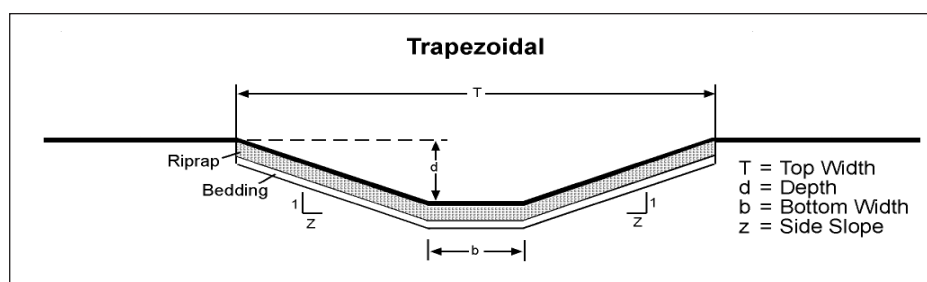


Figure 4.3.1

Rock Lining

The rock-lined channel shall consist of the rock riprap layer and an underlying filter or bedding. Minimum thickness of the rock riprap layer shall be the maximum stone size. Stone used for riprap shall be dense and hard enough to withstand exposure to air, water, freezing and thawing. Figure 4.3.2 gives the maximum depth of flow for riprap lined channels. Rock riprap must have a well-graded distribution and be placed in a to obtain a solid, compact layer of riprap. This may require some hand placing and tamping with construction equipment. Spreading gravel or soil over top of the placed riprap surface will fill the voids by interlocking the riprap together.

Filter or Granular Bedding

Filter or granular bedding must be placed beneath all riprap to prevent the underlying soil from eroding and undermining the riprap, and to collect seepage and base flow. Minimum bedding thickness shall be 4 inches. Use of large size riprap may necessitate the use of a thicker bedding layer or 2 differently sized bedding layers. Care should be taken to select a granular bedding that is suitable with the subgrade material.

Table 4.3.2 Rock Riprap Size

Type of Rock or Riprap (ODOT)	"n" value	Size of Rock	
		50% by weight	85% by weight
Type D	.036	> 6 in.	3 - 12 in.
Type C	.04	> 12 in.	6 - 18 in.
Type B	.043	> 18 in.	12 - 24 in.
Type A	.045	> 24 in.	18 - 30 in.

Adjustments to Naturalize Rock Lining

In order to more closely reflect the nature of the bed of a natural channel, smaller size graded stone may be used to fill the voids left in typical riprap applications.

Besides channel shape and pattern, typical rock lined channels depart from the flow behavior of natural channels by having too much pore space in the rock. Therefore regular flow is often entirely below the surface. This will be improved by extending the gradation of stone down to the gravel-sized material. This addition will increase velocity and reduce capacity slightly; therefore corresponding adjustments should be made.

Geotextile

Geotextile may be used as a filter to be placed beneath the riprap to prevent piping of the soil where wetness, seepage, or prolonged base flow is the reason for lining the channel with riprap. If design of the rock lined channel results in high velocities and steep grades, granular bedding should be used instead of geotextile. Care should be taken to properly anchor the geotextile to prevent unraveling under flowing water. Geotextile shall be woven or nonwoven monofilament yarn and shall meet Class I criteria in the attached table "Requirements for Geotextile".

Maintenance

A maintenance program shall be established to maintain capacity, vegetative cover above the riprap, and associated structural components such as inlets, outlets, and tile lines. Items to consider in the maintenance program include:

- Determine responsible party to inspect and maintain the channel after construction
- Protect the channel from damage by equipment, traffic, or livestock
- Fertilize the vegetated area annually to and maintain a vigorous stand of grass
- Mow the vegetated area to maintain a healthy and vigorous stand of grass.
- Repair damage to channels immediately. Missing riprap should be replaced as soon as possible. All broken subsurface drains should be repaired. Seed and mulch any bare areas that develop.
- Remove sediment and debris that have accumulated.
- Easements, or other means, should be obtained to ensure the channel is maintained as constructed

References

Additional guidance for evaluation, planning, and design of rock lined channels is given in:

- National Cooperative Highway Research Program Report 108 – Tentative Design Procedure for Riprap – Lined Channels
- NRCS Ohio Practice Standard 468, Lined Waterway Or Outlet
- NRCS Engineering Field Handbook, Chapter 6 - Structures
- NRCS Design Note 24, Guide for Use of Geotextiles

Table 4.3.3 Requirements for Geotextiles

Property	Test method	Woven - Class I	Nonwoven - Class I
Tensile strength (pounds) 1/	ASTM D 4632 grab test	200 minimum in any principal direction	180 minimum
Elongation at failure (percent) 1/	ASTM D 4632 grab test	<50	≥ 50
Puncture (pounds) 1/	ASTM D 4833	90 minimum	80 minimum
Ultraviolet light (% residual tensile strength)	ASTM D 4355 150-hr exposure	70 minimum	70 minimum
Apparent opening size (AOS)	ASTM D 4751	As specified, but no smaller than 0.212 mm (#70) 2/	As specified max. #40 2/
Percent open area (percent)	CWO-02215-86	4.0 minimum	-----
Permittivity sec-1	ASTM D 4491	0.10 minimum	0.70 minimum

1/ Minimum average roll value (weakest principal direction).

2/ U.S. standard sieve size.

Note: CWO is a USACE reference.

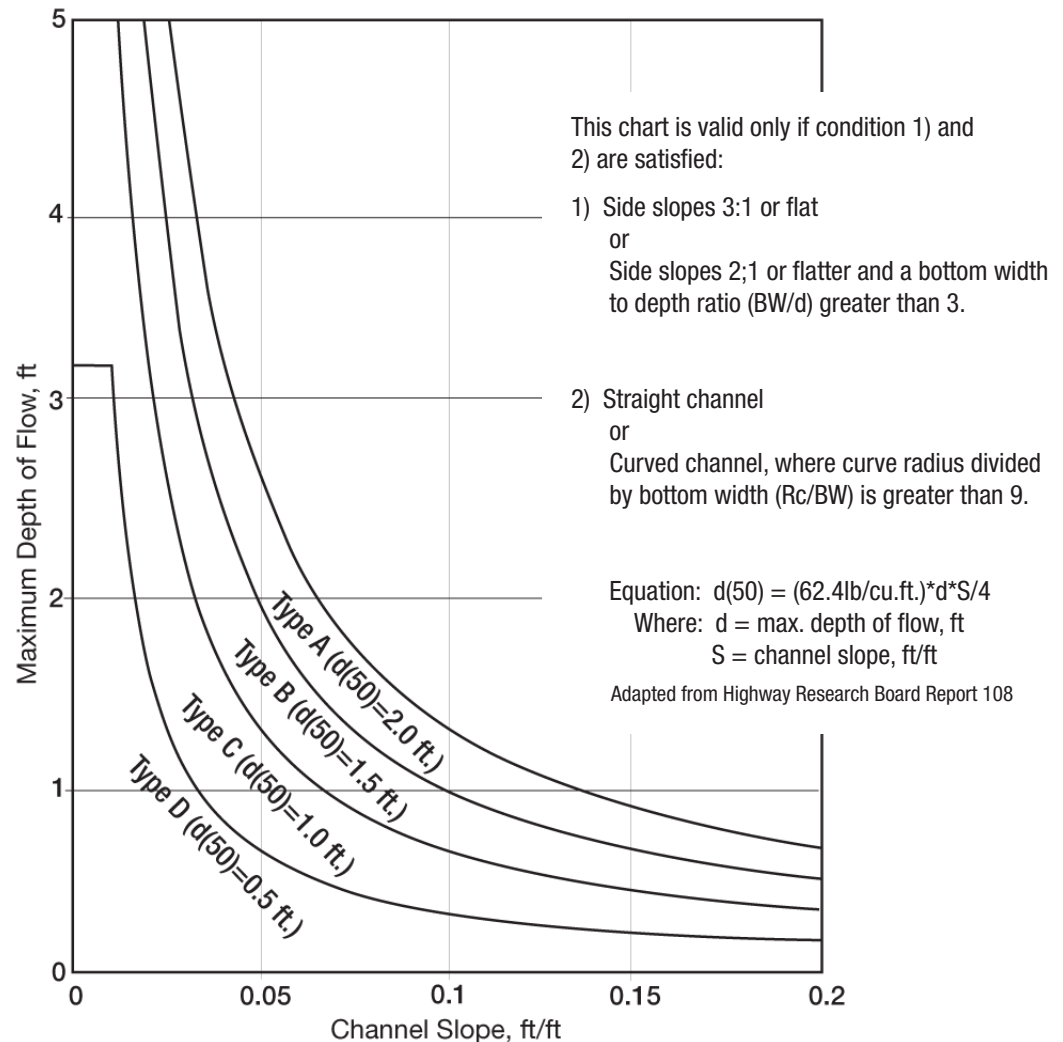
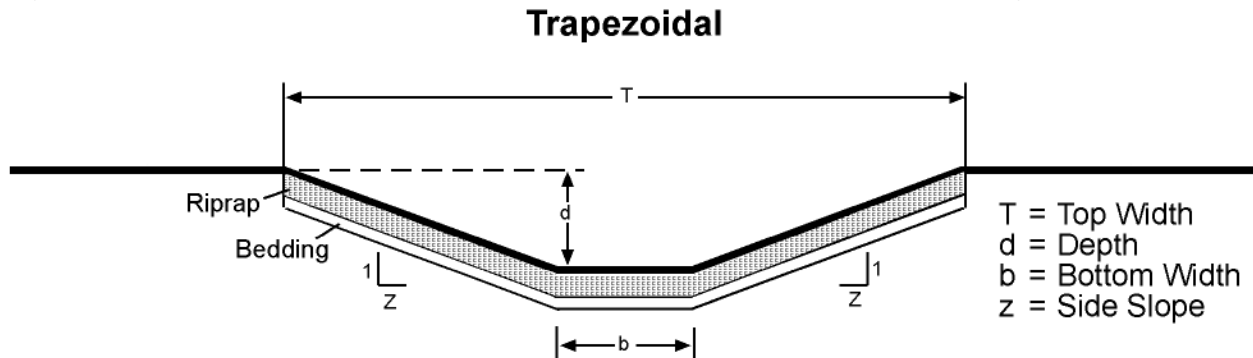


Figure 4.3.2 Maximum Depth of Flow for Riprap Lined Channels

Specifications
for
Rock Lined Channel



1. Subgrade for the filter and riprap shall be prepared to the required lines and grades as shown on the plan. The subgrade shall be cleared of all trees, stumps, roots, sod, loose rock, or other material.
2. Riprap shall conform to the grading limits as shown on the plan.
3. No abrupt deviations from the design grade or horizontal alignment shall be permitted.
4. Geotextile shall be securely anchored according to manufacturers recommendations.
5. Geotextile shall be laid with the long dimension parallel to the direction of flow and shall be laid loosely but without wrinkles and creases. Where joints are necessary, strips shall be placed to provide a 12-in. minimum overlap, with the upstream strip overlapping the downstream strip.
6. Gravel bedding shall be ODOT No. 67's or 57's unless shown differently on the drawings.
7. Riprap may be placed by equipment but shall be placed in a manner to prevent slippage or damage to the geotextile.
8. Riprap shall be placed by a method that does not cause segregation of sizes. Extensive pushing with a dozer causes segregation and shall be avoided by delivering riprap near its final location within the channel.
9. Construction shall be sequenced so that riprap channel protection is placed and functional without delays when the channel becomes operational.
10. All disturbed areas will be vegetated as soon as practical.

Description

Rough cut street controls are rock or earthen berms placed along dirt roadways that are under construction or used for construction access. These temporary berms intercept sheet flow and divert runoff from the roadway, and control erosion by minimizing concentration of flow and reducing runoff velocity.

Appropriate Uses

Appropriate uses include:

- Temporary dirt construction roadways that have not received roadbase.
- Roadways under construction that will not be paved within 14 days of final grading, and that have not yet received roadbase.



Photograph RCS-1. Rough cut street controls.

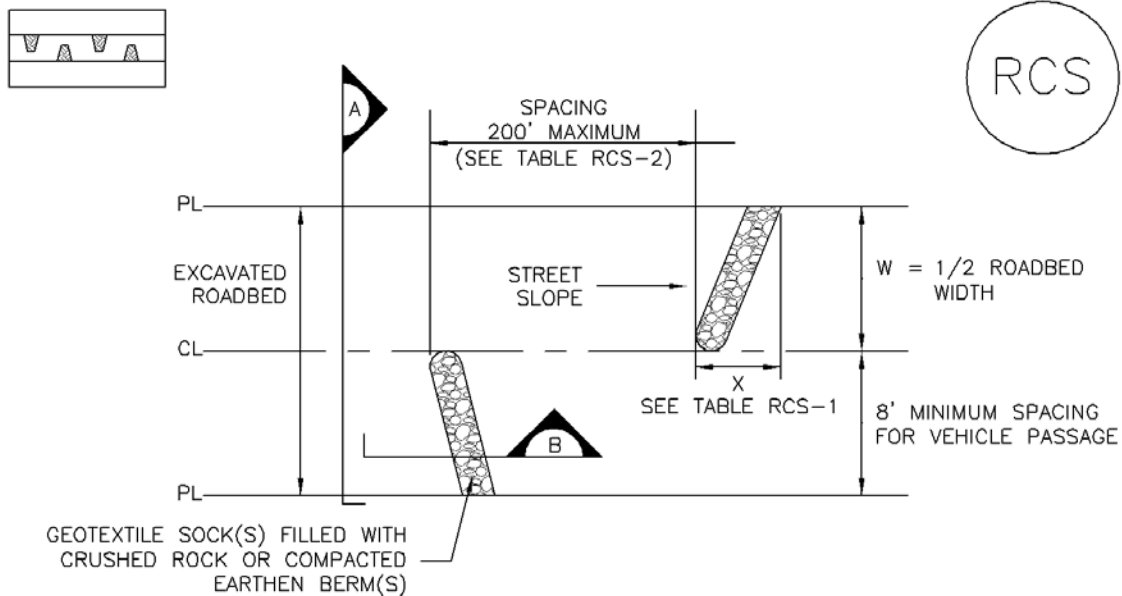
Design and Installation

Rough cut street controls are designed to redirect sheet flow off the dirt roadway to prevent water from concentrating and eroding the soil. These controls consist of runoff barriers that are constructed at intervals along the road. These barriers are installed perpendicular to the longitudinal slope from the outer edge of the roadside swale to the crown of the road. The barriers are positioned alternately from the right and left side of the road to allow construction traffic to pass in the lane not barred. If construction traffic is expected to be congested and a vehicle tracking control has been constructed, rough-cut street controls may be omitted for 400 feet from the entrance. Runoff from the controls should be directed to another stormwater BMP such as a roadside swale with check dams once removed from the roadway. See Detail RCS-1 for additional information.

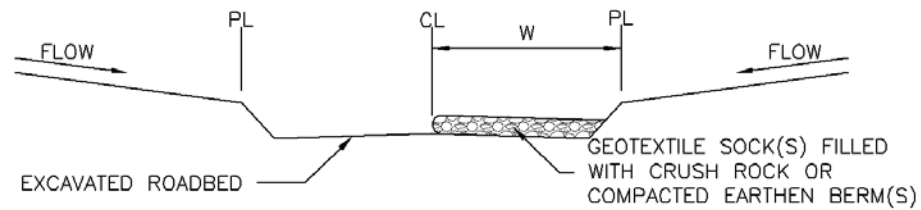
Maintenance and Removal

Inspect street controls for erosion and stability. If rills are forming in the roadway or cutting through the control berms, place the street controls at shorter intervals. If earthen berms are used, periodic recompaction may be necessary. When rock berms are used, repair and/or replace as necessary when damaged. Street controls may be removed 14 days prior to road surfacing and paving.

Rough Cut Street Control	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No



ROUGH CUT STREET CONTROL PLAN



SECTION A



SECTION B

TABLE RCS-1

W (FT)	X (FT)
20-30	5
31-40	7
41-50	9
51-60	10.5
61-70	12

TABLE RCS-2

LONGITUDINAL STREET SLOPE (%)	SPACING (FT)
<2	NOT TYPICALLY NEEDED
2	200
3	200
4	150
5	100
6	50
7	25
8	25

RCS-1. ROUGH CUT STREET CONTROL

ROUGH CUT STREET CONTROL INSTALLATION NOTES

1. SEE PLAN VIEW FOR
-LOCATION OF ROUGH CUT STREET CONTROL MEASURES.
2. ROUGH CUT STREET CONTROL SHALL BE INSTALLED AFTER A ROAD HAS BEEN CUT IN, AND WILL NOT BE PAVED FOR MORE THAN 14 DAYS OR FOR TEMPORARY CONSTRUCTION ROADS THAT HAVE NOT RECEIVED ROAD BASE.

ROUGH CUT STREET CONTROL INSPECTION AND MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

(DETAILS ADAPTED FROM AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Earth dikes and drainage swales are temporary storm conveyance channels constructed either to divert runoff around slopes or to convey runoff to additional sediment control BMPs prior to discharge of runoff from a site. Drainage swales may be lined or unlined, but if an unlined swale is used, it must be well compacted and capable of resisting erosive velocities.

Appropriate Uses

Earth dikes and drainage swales are typically used to control the flow path of runoff at a construction site by diverting runoff around areas prone to erosion, such as steep slopes. Earth dikes and drainage swales may also be constructed as temporary conveyance features. This will direct runoff to additional sediment control treatment BMPs, such as sediment traps or basins.



Photograph ED/DS-1. Example of an earth dike used to divert flows at a construction site. Photo courtesy of CDOT.

Design and Installation

When earth dikes are used to divert water for slope protection, the earth dike typically consists of a horizontal ridge of soil placed perpendicular to the slope and angled slightly to provide drainage along the contour. The dike is used in conjunction with a swale or a small channel upslope of the berm to convey the diverted water. Temporary diversion dikes can be constructed by excavation of a V-shaped trench or ditch and placement of the fill on the downslope side of the cut. There are two types of placement for temporary slope diversion dikes:

- A dike located at the top of a slope to divert upland runoff away from the disturbed area and convey it in a temporary or permanent channel.
- A diversion dike located at the base or mid-slope of a disturbed area to intercept runoff and reduce the effective slope length.

Depending on the project, either an earth dike or drainage swale may be more appropriate. If there is a need for cut on the project, then an excavated drainage swale may be better suited. When the project is primarily fill, then a conveyance constructed using a berm may be the better option.

All dikes or swales receiving runoff from a disturbed area should direct stormwater to a sediment control BMP such as a sediment trap or basin.

Earth Dikes and Drainage Swales	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

EC-10 Earth Dikes and Drainage Swales (ED/DS)

Unlined dikes or swales should only be used for intercepting sheet flow runoff and are not intended for diversion of concentrated flows.

Details with notes are provided for several design variations, including:

ED-1. Unlined Earth Dike formed by Berm

DS-1. Unlined Excavated Swale

DS-2. Unlined Swale Formed by Cut and Fill

DS-3. ECB-lined Swale

DS-4. Synthetic-lined Swale

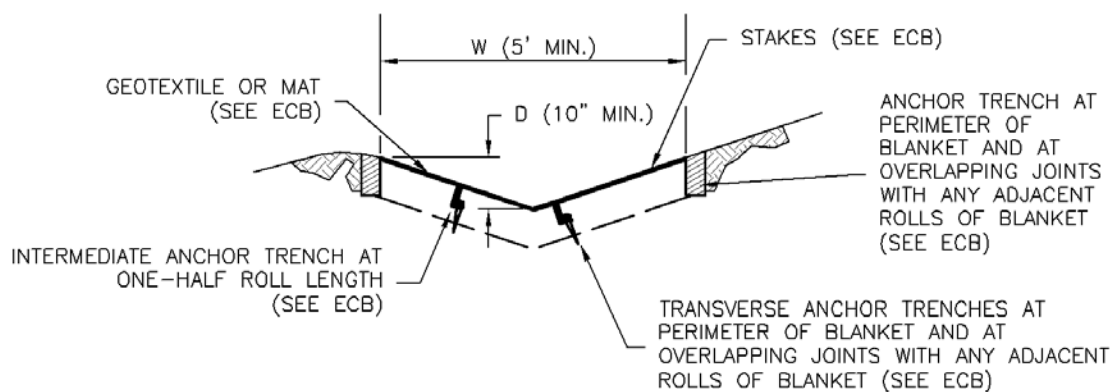
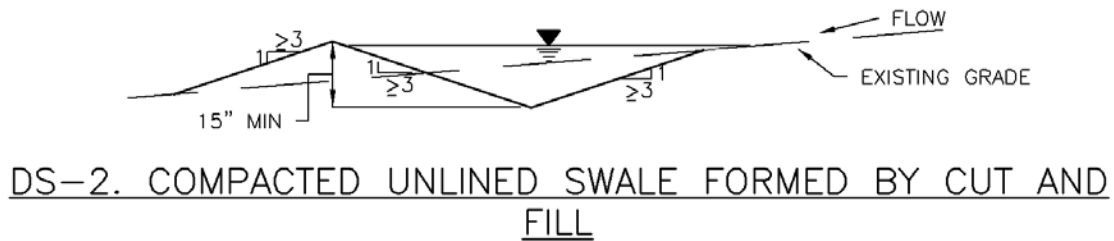
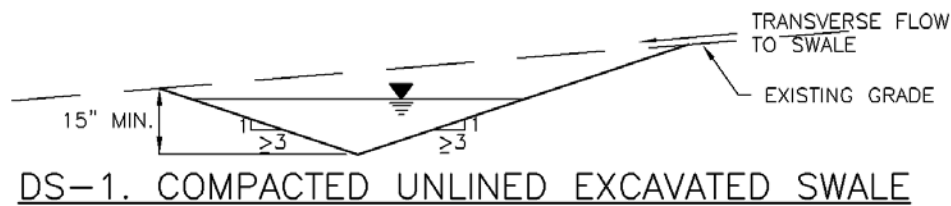
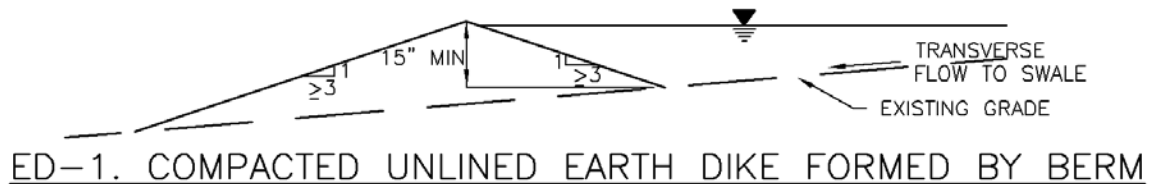
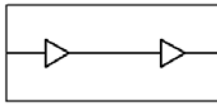
DS-5. Riprap-lined Swale

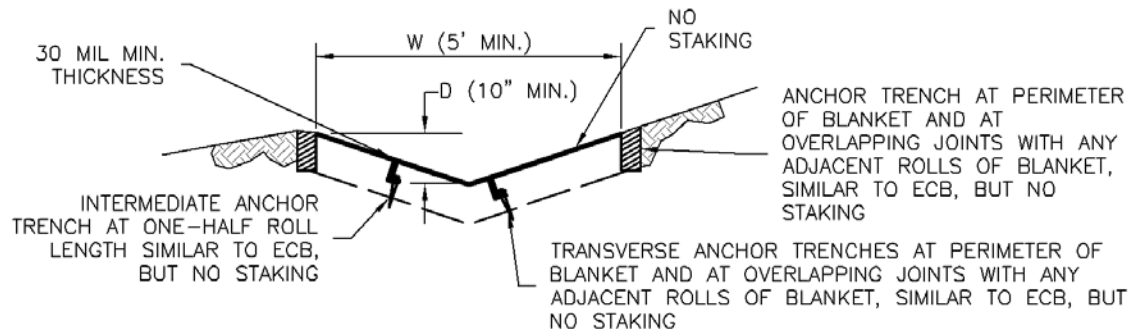
The details also include guidance on permissible velocities for cohesive channels if unlined approaches will be used.

Maintenance and Removal

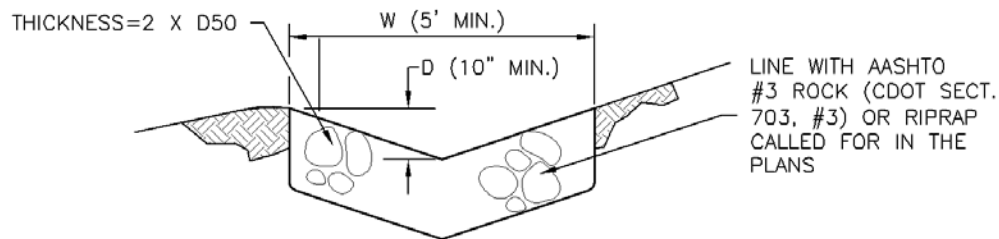
Inspect earth dikes for stability, compaction, and signs of erosion and repair. Inspect side slopes for erosion and damage to erosion control fabric. Stabilize slopes and repair fabric as necessary. If there is reoccurring extensive damage, consider installing rock check dams or lining the channel with riprap.

If drainage swales are not permanent, remove dikes and fill channels when the upstream area is stabilized. Stabilize the fill or disturbed area immediately following removal by revegetation or other permanent stabilization method approved by the local jurisdiction.





DS-4. SYNTHETIC LINED SWALE



DS-5. RIPRAP LINED SWALE

EARTH DIKE AND DRAINAGE SWALE INSTALLATION NOTES

1. SEE SITE PLAN FOR:
 - LOCATION OF DIVERSION SWALE
 - TYPE OF SWALE (UNLINED, COMPACTED AND/OR LINED).
 - LENGTH OF EACH SWALE.
 - DEPTH, D, AND WIDTH, W DIMENSIONS.
 - FOR ECB/TRM LINED DITCH, SEE ECB DETAIL.
 - FOR RIPRAP LINED DITCH, SIZE OF RIPRAP, D50.
2. SEE DRAINAGE PLANS FOR DETAILS OF PERMANENT CONVEYANCE FACILITIES AND/OR DIVERSION SWALES EXCEEDING 2-YEAR FLOW RATE OR 10 CFS.
3. EARTH DIKES AND SWALES INDICATED ON SWMP PLAN SHALL BE INSTALLED PRIOR TO LAND-DISTURBING ACTIVITIES IN PROXIMITY.
4. EMBANKMENT IS TO BE COMPACTED TO 90% OF MAXIMUM DENSITY AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT ACCORDING TO ASTM D698.
5. SWALES ARE TO DRAIN TO A SEDIMENT CONTROL BMP.
6. FOR LINED DITCHES, INSTALLATION OF ECB/TRM SHALL CONFORM TO THE REQUIREMENTS OF THE ECB DETAIL.
7. WHEN CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION SWALE, INSTALL A TEMPORARY CULVERT WITH A MINIMUM DIAMETER OF 12 INCHES.

EARTH DIKE AND DRAINAGE SWALE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SWALES SHALL REMAIN IN PLACE UNTIL THE END OF CONSTRUCTION; IF APPROVED BY LOCAL JURISDICTION, SWALES MAY BE LEFT IN PLACE.
5. WHEN A SWALE IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF COLORADO SPRINGS, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Terracing involves grading steep slopes into a series of relatively flat sections, or terraces, separated at intervals by steep slope segments. Terraces shorten the uninterrupted flow lengths on steep slopes, helping to reduce the development of rills and gullies. Retaining walls, gabions, cribbing, deadman anchors, rock-filled slope mattresses, and other types of soil retention systems can be used in terracing.



Photograph TER-1. Use of a terrace to reduce erosion by controlling slope length on a long, steep slope. Photo courtesy of Douglas County.

Appropriate Uses

Terracing techniques are most typically used to control erosion on slopes that are steeper than 4:1.

Design and Installation

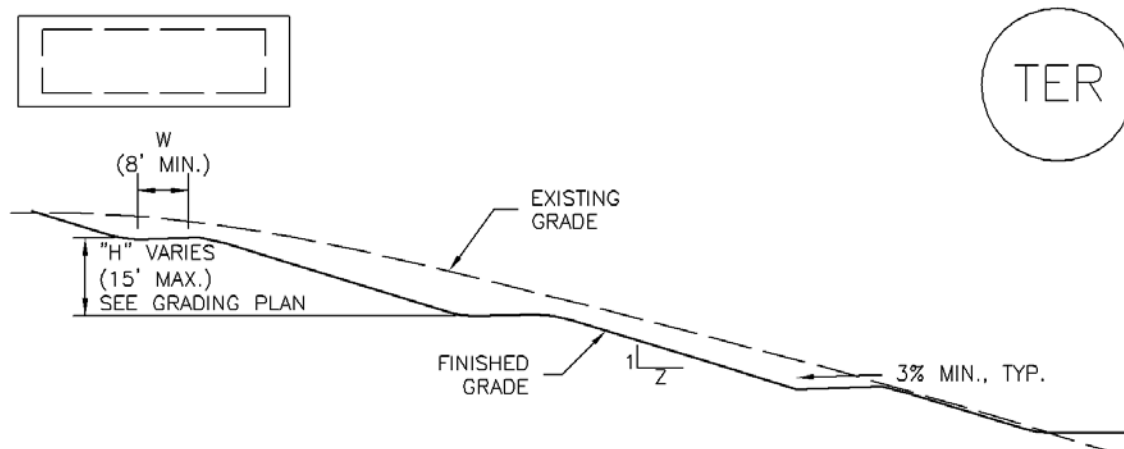
Design details with notes are provided in Detail TER-1.

The type, number, and spacing of terraces will depend on the slope, slope length, and other factors. The Revised Universal Soil Loss Equation (RUSLE) may be helpful in determining spacing of terraces on slopes. Terracing should be used in combination with other stabilization measures that provide cover for exposed soils such as mulching, seeding, surface roughening, or other measures.

Maintenance and Removal

Repair rill erosion on slopes and remove accumulated sediment, as needed. Terracing may be temporary or permanent. If terracing is temporary, the slope should be topsoiled, seeded, and mulched when the slope is graded to its final configuration and terraces are removed. Due to the steepness of the slope, once terraces are graded, erosion control blankets or other stabilization measures are typically required. If terraces are permanent, vegetation should be established on slopes and terraces as soon as practical.

Terracing	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No



TER-1. TERRACING

TERRACING INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATION OF TERRACING
 - WIDTH (W), AND SLOPE (Z).
2. TERRACING IS TYPICALLY NOT REQUIRED FOR SLOPES OF 4:1 OR FLATTER.
3. GRADE TERRACES TO DRAIN BACK TO SLOPE AT A MINIMUM OF 3% GRADE.

TERRACING MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. RILL EROSION OCCURRING ON TERRACED SLOPES SHALL BE REPAIRED, RESEED, MULCHED OR STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.
5. TERRACING MAY NEED TO BE RE-GRADED TO RETURN THE SLOPE TO THE FINAL DESIGN GRADE. THE SLOPE SHALL THEN BE COVERED WITH TOPSOIL, SEED, AND MULCHED, OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

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Check Dam (CD)

EC-12



Description

Check dams are small, temporary dams constructed across a diversion or roadside ditch. Check dams can be constructed using gravel, rock, sandbags, gravel bags, earth with erosion control blanketing, straw bales, or wattles and are used to slow the velocity of concentrated flow in a channel and thus reduce erosion. As a secondary function, check dams can also be used to catch sediment from the channel itself or from the contributing drainage area as storm water runoff flows through or over the structure.

Applicability

Check dams are most often used in small, open channels with a contributing drainage area of less than 10 acres, and side slopes of 2:1 or less. Check dams may be used in the following applications:

- In diversions or roadside ditches where it is not practical to line the channel or implement other flow control and sediment control practices.
- In diversions or roadside ditches where temporary seeding has been recently implemented but has not had time to take root and fully develop.
- As a series of check dams, spaced at appropriate intervals, used in one of the above two applications.

Limitations

- Check dams should not be used in live, continuously flowing streams unless approved by an appropriate regulatory agency.
- Check dams may require frequent removal of accumulated sediments. Dams should therefore be located in areas accessible to maintenance vehicles.
- Leaves have been shown to be a significant problem by clogging check dams in the fall. Therefore, they might necessitate increased inspection and maintenance.

- Straw bale check dams decompose over time, and may be consumed by livestock.

Design Criteria

No formal design is required.

Construction Specifications

1. Install straw bale check dams and rock check dams according to Figures CD-1 and CD-2, respectively. Other types of check dams shall have similar designs.
2. Check dams should be located in areas accessible to maintenance vehicles for the periodic removal of accumulated sediments.
3. Dams should be installed with careful placement of the construction material. Mere dumping of the dam material into a channel is not appropriate and will reduce overall effectiveness.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). During inspection, large debris, trash, and leaves should be removed. The center of a check dam should always be lower than its edges. If erosion or heavy flows cause the edges of a dam to fall to a height equal to or below the height of the center, and the effectiveness of the check dam is compromised, repairs should be made immediately. Accumulated sediment should be removed from the upstream side of a check dam when the sediment has reached a height of approximately one-half the original height of the dam (measured at the center). Close attention should be paid to the repair of damaged or rotting straw bales, end runs and undercutting beneath bales. Replacement of bales should be accomplished promptly.

Check dams should be installed closely enough to one another to sufficiently slow the flow of water to prevent both damage to the dams and passage of the water under or around them. The steeper the slope, the more closely the dams will need to be spaced. If the dams are proving insufficient for the flow, more of them may need to be installed. Ideally, the top of one dam would be level with the toe of the next upstream dam.

Removal

Removal of check dams is optional. Check dams within roadside ditches are usually used as temporary controls, where other check dams may be left in place to silt out. If removing a check dam, all accumulated sediment should be removed. Removal of a check dam should be completed only after the contributing drainage area has been completely stabilized. Permanent vegetation should replace areas from which rock or other material has been removed.

References

Colorado Department of Transportation (CDOT), *Erosion Control and Stormwater Quality Guide*. 2002.

<<http://www.dot.state.co.us/environmental/envWaterQual/wqms4.asp>>

Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February, 2003.

http://cfpub.epa.gov/npdes/stormwater/menuofbmps/con_site.cfm

Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

**Figure CD-1
Straw Bale Check Dam Installation**

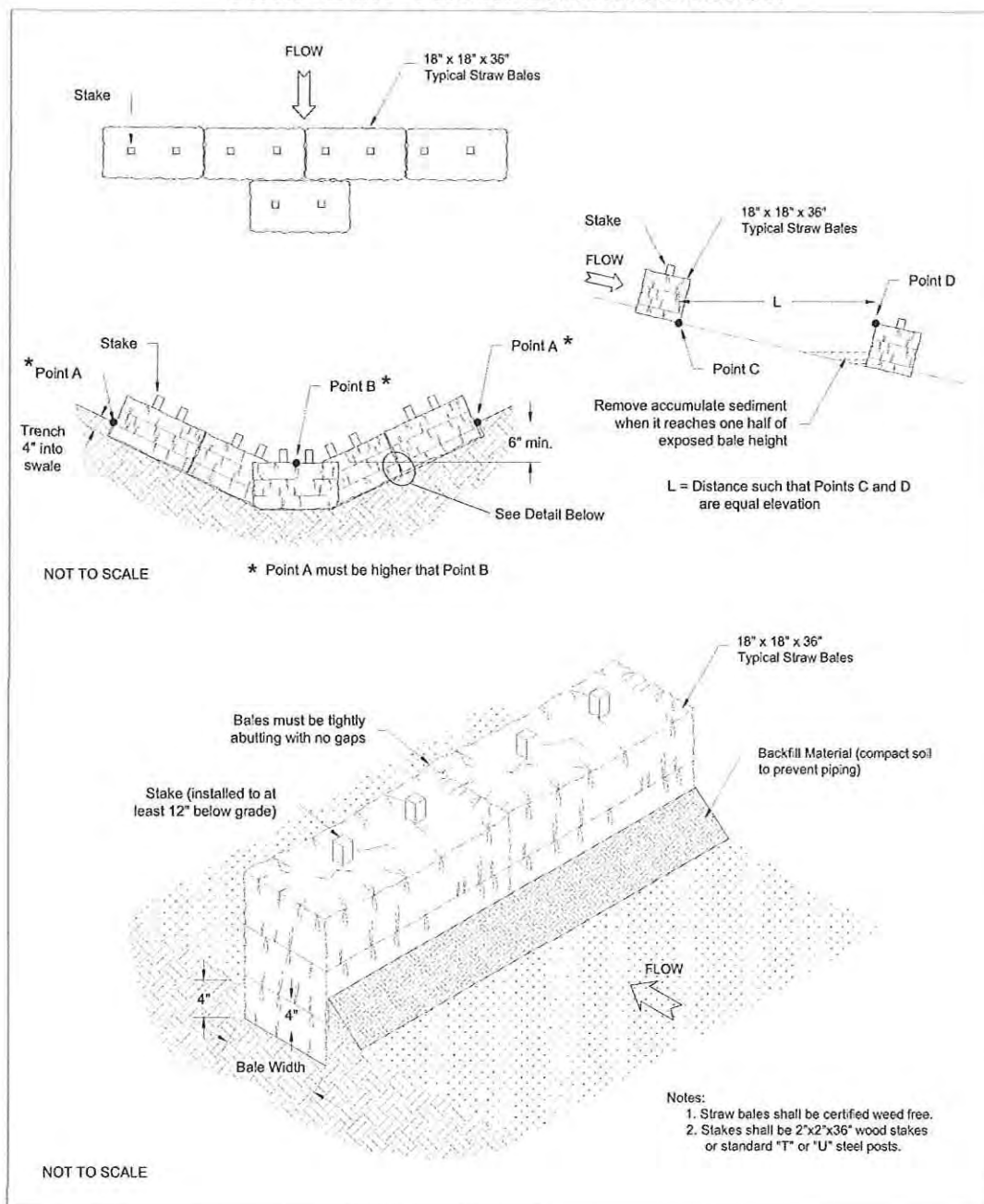
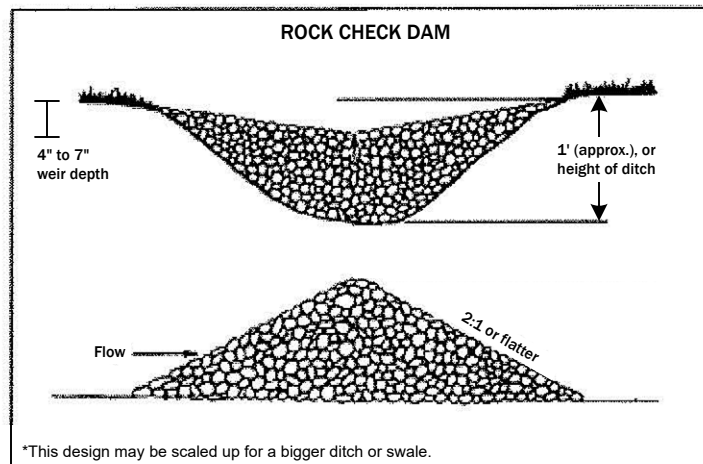


Figure CD-2
Rock Check Dam Installation



Derived from: Virginia Soil and Water Conservation Commission, 1989

Description

Streambank stabilization involves a combination of erosion and sediment control practices to protect streams, banks, and in-stream habitat from accelerated erosion. BMPs associated with streambank stabilization may include protection of existing vegetation, check dams/grade control, temporary and permanent seeding, outlet protection, rolled erosion control products, temporary diversions, dewatering operations and bioengineering practices such as brush layering, live staking and fascines.



Photograph SS-1. Streambank stabilization using geotextiles following installation of a permanent in-stream grade control structure.

Appropriate Uses

Streambank stabilization may be a construction activity in and of itself, or it may be in conjunction with a broader construction project that discharges to a waterway that is susceptible to accelerated erosion due to increases in the rate and volume of stormwater runoff. Depending on the health of the stream, water quality sampling and testing may be advisable prior to and/or during construction to evaluate health and stability of the stream and potential effects from adjacent construction activities.

Design and Installation

Streambank stabilization consists of protecting the stream in a variety of ways to minimize negative effects to the stream environment. The following lists the minimum requirements necessary for construction streambank stabilization:

- Protect existing vegetation along the stream bank in accordance with the Vegetated Buffers and Protection of Existing Vegetation Fact Sheets. Preserving a riparian buffer along the streambank will help to remove sediment and decrease runoff rates from the disturbed area.
- Outside the riparian buffer, provide sediment control in the form of a silt fence or equivalent sediment control practice along the entire length of the stream that will receive runoff from the area of disturbance. In some cases, a double-layered perimeter control may be justified adjacent to sensitive receiving waters and wetlands to provide additional protection.
- Stabilize all areas that will be draining to the stream. Use rolled erosion control products, temporary or permanent seeding, or other appropriate measures.
- Ensure all point discharges entering the stream are adequately armored with a velocity dissipation device and appropriate outlet protection.

See individual design details and notes for the various BMPs referenced in this practice. Additional information on bioengineering techniques for stream stabilization can be

Streambank Stabilization	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

found in the *Major Drainage* chapter of Volume 1 and additional guidance on BMPs for working in waterways can be found in UDFCD's *Best Management Practices for Construction in Waterways Training Manual*.

Maintenance and Removal

Inspect BMPs protecting the stream for damage on a daily basis. Maintain, repair, or replace damaged BMPs following the guidance provided in individual BMP Fact Sheets for practices that are implemented. Some streambank stabilization BMPs are intended to remain in place as vegetation matures (e.g. erosion control blankets protecting seeded stream banks and turf reinforcement mats).

For BMPs that are not to remain in place as a part of final stabilization such as silt fence and other temporary measures, BMPs should be removed when all land disturbing activities have ceased and areas have been permanently stabilized.

Description

Wind erosion and dust control BMPs help to keep soil particles from entering the air as a result of land disturbing construction activities. These BMPs include a variety of practices generally focused on either graded disturbed areas or construction roadways. For graded areas, practices such as seeding and mulching, use of soil binders, site watering, or other practices that provide prompt surface cover should be used. For construction roadways, road watering and stabilized surfaces should be considered.



Photograph DC-1. Water truck used for dust suppression. Photo courtesy of Douglas County.

Appropriate Uses

Dust control measures should be used on any site where dust poses a problem to air quality. Dust control is important to control for the health of construction workers and surrounding waterbodies.

Design and Installation

The following construction BMPs can be used for dust control:

- An irrigation/sprinkler system can be used to wet the top layer of disturbed soil to help keep dry soil particles from becoming airborne.
- Seeding and mulching can be used to stabilize disturbed surfaces and reduce dust emissions.
- Protecting existing vegetation can help to slow wind velocities across the ground surface, thereby limiting the likelihood of soil particles to become airborne.
- Spray-on soil binders form a bond between soil particles keeping them grounded. Chemical treatments may require additional permitting requirements. Potential impacts to surrounding waterways and habitat must be considered prior to use.
- Placing rock on construction roadways and entrances will help keep dust to a minimum across the construction site.
- Wind fences can be installed on site to reduce wind speeds. Install fences perpendicular to the prevailing wind direction for maximum effectiveness.

Maintenance and Removal

When using an irrigation/sprinkler control system to aid in dust control, be careful not to overwater. Overwatering will cause construction vehicles to track mud off-site.

Wind Erosion Control/ Dust Control	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	Moderate



Description

Culverts are typically concrete, steel, aluminum, or plastic pipe used to move ditch water under the road or to direct stream flow under the road or construction area.

Applicability

Culverts are ideal on road grades less than 15%. For grades over 15%, it is difficult to slow down the water or remove it from the road surface rapidly. On such steep grades, it is best to use frequently spaced relief culverts and drainage crossing culverts, with armored ditches (see RIPRAP [R]). Culverts may be used in the following applications:

- As drainage crossing culverts in streams and gullies to allow normal drainage to flow under the traveled way.
- As ditch relief culverts to periodically relieve the inside ditch line flow by piping water to the opposite side of the road where the flow can be dispersed away from the roadway. Culverts placed in natural drainages may be utilized for ditch relief.

Limitations

- If undersized, culverts are susceptible to plugging and require cleaning.
- Culverts will not filter sediment.
- Culverts are easily crushed if not properly designed.

Design Criteria

Capacity

All culverts should be designed for a minimum 25-year-frequency storm with an allowable head that does not overlap the roadway. However, the minimum acceptable size culvert diameter to prevent failure from debris blockage is 18 inches for intermittent stream crossings and 36 inches for perennial stream crossings. Pipe size can be determined using general design criteria, such as in Table C-1, but is ideally based upon site-specific hydrologic analysis.

Depth

The depth of culvert burial must be sufficient to ensure protection of the culvert barrel for the design life of the culvert. This requires anticipating the amount of material that may be lost due to road use and erosion.

Headwalls

Use headwalls on culvert pipes as often as possible (see RETAINING WALL [RW]). The advantages of headwalls include: preventing large pipes from floating out of the ground when they plug; reducing the length of the pipe; increasing pipe capacity; helping to funnel debris through the pipe; retaining the backfill material; and reducing the chances of culvert failure if it is overtopped.

Construction Specifications

Drainage crossing culverts

1. Make road crossings of natural drainages perpendicular to the drainage to minimize pipe length and area of disturbance (Figure C-1).
2. Use single large pipes versus multiple smaller diameter pipes to minimize plugging potential in most channels (unless roadway elevation is critical). In very broad channels, multiple pipes are desirable to maintain the natural flow spread across the channel. All culverts should be concrete, corrugated metal pipe (CMP) made of steel or aluminum, or properly bedded and backfilled corrugated plastic pipe.
3. Align culverts in the bottom and middle of the natural channel flowline so that installation causes no change in the stream channel alignment or stream bottom elevation. Culverts should not cause damming or pooling or increase stream velocities significantly.
4. Extend the outlet of the culvert at least one foot beyond the toe of the slope to prevent erosion of the fill material. Alternatively, use retaining walls (headwalls) to hold back the fill slope.
5. It may be necessary to install rip-rap, erosion control blanketing, a combination of the riprap and blanketing, or other energy dissipater device

at the outlet end of the culvert to reduce soil erosion or to trap sediment (see CULVERT PROTECTION [CP]).

6. It may be desirable to construct pulloffs/turnouts for vehicles on one or both sides of narrow culvert crossings. This will help avoid culvert crushing as well as disturbance to roadside ditches and berms.

Ditch relief culverts

1. See Figure C-2 for installation details.
2. Ditch relief culverts can provide better flow when skewed 0 to 30 degrees perpendicular to the road.
3. The culvert gradient should be at least 2% greater than the approach ditch gradient. This improves the flow hydraulics and reduces siltation and debris from plugging the culvert inlet.
4. Discharge culvert at natural ground level where possible (see Figure C-3 – Type A), on firm, non-erosive soil or in rocky or brushy areas. If discharged on the fill slopes, armor outlets with riprap or logging slash (see Figure C-3 – Type B), or use down-drain structures (see Figure C-3 – Type C and SLOPE DRAIN [SD]).
5. Extend the inlet of the culvert at least one foot beyond the flowline of the roadside ditch. Extend the outlet of the culvert at least one foot beyond the toe of slopes to prevent erosion of the fill material.
6. It may be necessary to install rip-rap or other energy dissipater devices at the outlet end of the culvert to prevent soil erosion or to trap sediment (see CULVERT PROTECTION [CP]).
7. Spacing of culverts is dependent on the road gradient, soil types, and runoff characteristics according to the following table:

Soil Type	Road Grade		
	2-4%	5-8%	9-12%
Highly corrosive granitic or sandy	240'	180'	140'
Intermediate erosive clay or loam	310'	260'	200'
Low erosive shale or gravel	400'	325'	250'

8. It may be desirable to construct pulloffs/turnouts for vehicles on one or both sides of narrow culvert crossings. This will help avoid culvert crushing as well as disturbance to roadside ditches and berms.

Backfill and Compaction

1. See Figure C-4.

2. Firmly compact well-graded fill material (soil or road base) around culverts, particularly around the bottom half, using placement in layers to achieve a uniform density. Use slightly plastic sandy gravel with fines. Avoid the use of fine sand and silt rich soils for bedding material because of their susceptibility to piping. Pay particular attention to culvert bedding and compaction around the haunches of the pipe. Do not allow the compaction to move or raise the pipe. In large fills, allow for settlement.
3. Cover the top of metal and plastic culvert pipes with fill to a depth of at least 1 foot to prevent pipe crushing by heavy trucks. Use a minimum cover of 2 feet of fill over concrete pipe. For maximum allowable fill height, follow the manufacturer's recommendations.
4. Mound fill over the top of culvert pipes so that the road is slightly raised at culvert locations to help prevent erosion and water from ponding over culvert crossings. This practice, as well as placing large boulders around the culvert outlets, will also help to prevent culverts from crushing.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). If any damage to culvert or inlet/outlet protection is noted or if there is any evidence of scour, repairs should be made immediately. Any debris that may be blocking the culvert inlet or outlet should be removed.

References

Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

Keller, Gordon, and James Sherar, *Low-Volume Roads Engineering, Best Management Practices Field Guide*. United States Department of Agriculture (USDA), Forest Service, US Agency of International Development (USAID), 2005. <<http://www.blm.gov/bmp/field%20guide.htm>>

United States Department of the Interior and United States Department of Agriculture. *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development "Gold Book"*. BLM/WO/ST-06/021+3071. Bureau of Land Management (BLM). Denver, Colorado. Fourth Edition, 2006.

**Table C-1
Culvert Sizing**

Drainage Area (acres)	Size of Drainage Structure (diameter and area)			
	Steep Slopes (Light Vegetation) C=0.7		Gentle Slopes (Heavy Vegetation) C=0.2	
	Round Pipe (in)	Area (sq. ft)	Round Pipe (in)	Area (sq. ft)
0 - 10	30"	4.9	18"	1.8
10 - 20	42"	9.6	24"	3.1
20 - 35	48"	12.6	30"	4.9
35 - 75	72"	28.3	42"	9.6
75 - 125	84"	38.5	48"	12.6
125 - 200	96"	50.3	60"	19.6

Notes: If pipe size is not available, use the next larger pipe size for the given drainage area. For intermediate terrain, interpolate between pipe sizes. Pipe size is based upon the Rational Formula and Culvert Capacity curves. Assumes a rainfall intensity of 3 to 4 in/hr. Values of "C" are the Runoff Coefficients for the terrain.

**Figure C-1
Drainage Crossing Culvert Alignment & Overflow Dip**

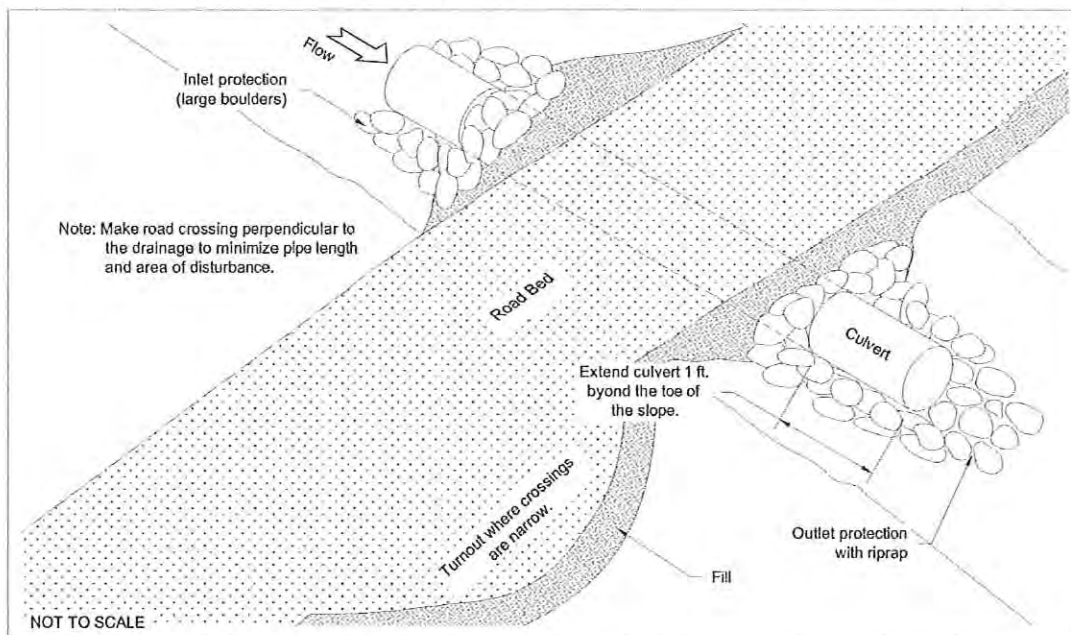


Figure C-2
Ditch Relief Culvert Installation

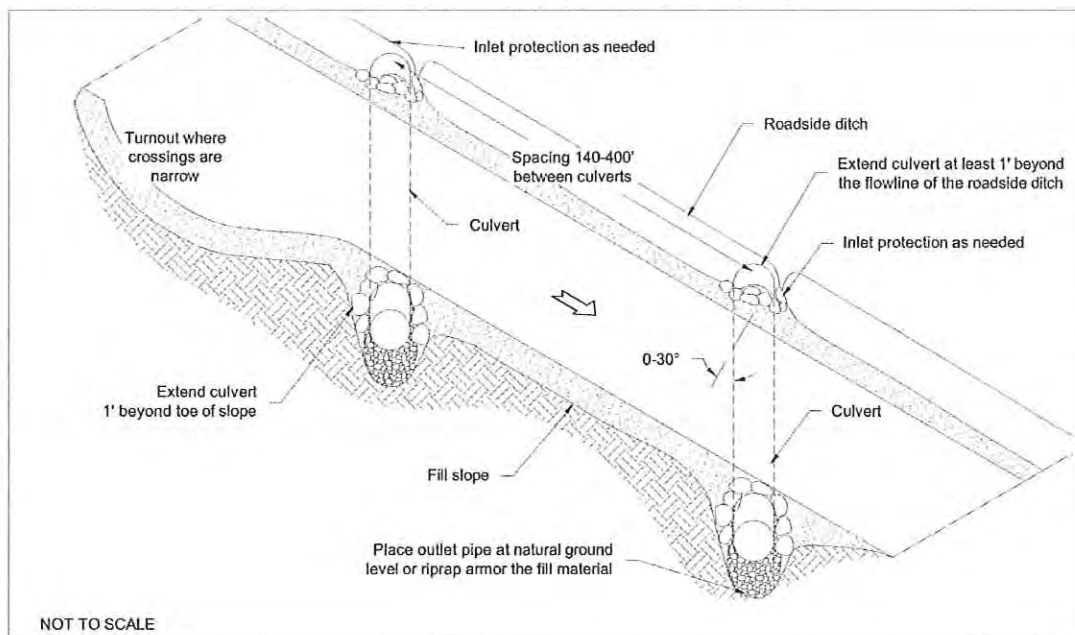


Figure C-3
Culvert Installation Options

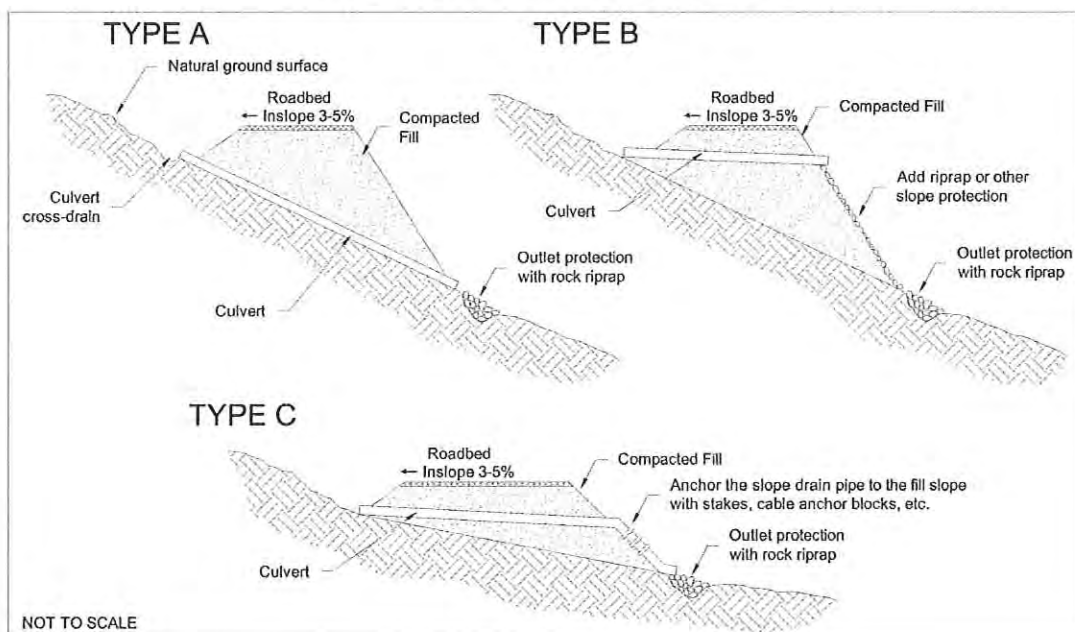
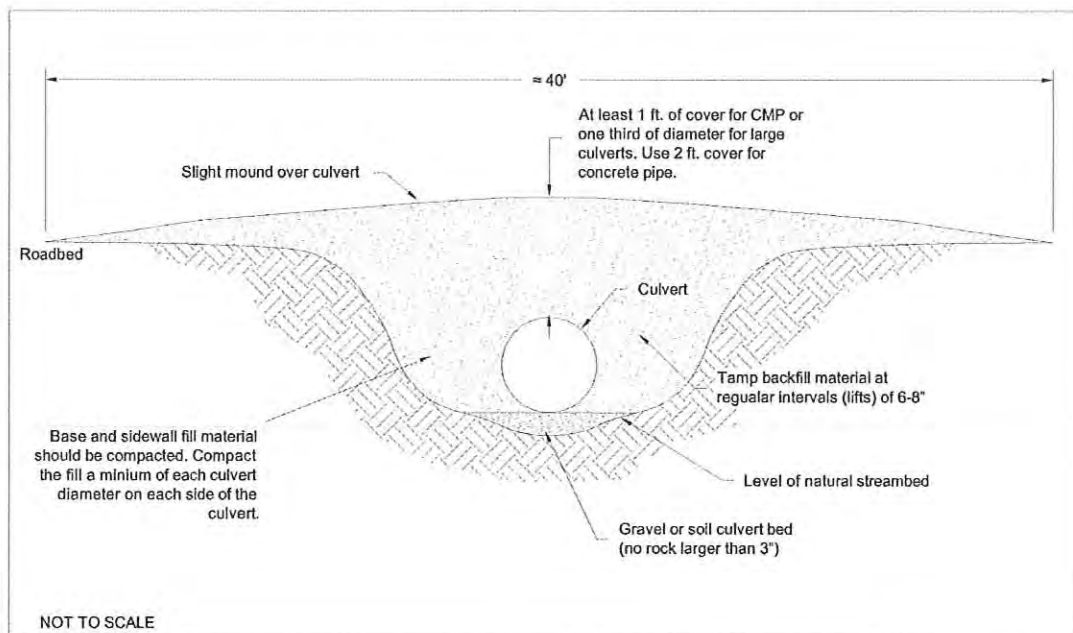


Figure C-4
Culvert Backfill and Compaction





Description

Culvert protection may be required at the inlet to the culvert (upstream side) and/or the outlet to the culvert (downstream side).

Culvert inlet protection could involve placing boulders, riprap, gabions, rock retaining walls, slash, and/or any other protection at the inlets of pipes. Riprap, or other energy-dissipating devices, will reduce the velocity of storm water flows and thereby prevent erosion and help protect the inlet structure.

Culvert outlet protection involves placing structurally lined aprons or other appropriate energy-dissipating devices, such as large boulders or plunge pools, at the outlets of pipes to reduce the velocity of storm water flows and thereby prevent scouring at storm water outlets, protect the outlet structure, and minimize potential for erosion downstream.

Applicability

Riprap inlet protection should be used where velocities and energies at the inlets of culverts are sufficient to erode around the inlet structure. Riprap may also be used to help channel the storm water to the inlet of the culvert.

Culvert outlet protection should be used where discharge velocities and energies at the outlets of culverts or channels are sufficient to erode the next downstream reach.

Limitations

Rock aprons at culvert outlets should not be placed on slopes steeper than 10 percent. Runoff from pipe outlets at the top of cuts/fills or on slopes steeper than 10 percent should be routed via slope drains or riprap chutes to a rock apron at the toe of the slope. Otherwise flows will re-concentration and gain velocities as the flow leaves the apron.

Design Criteria

Culvert Inlet Protection

Riprap, gabions, or rock retaining walls at culvert inlets shall be designed according to RIPRAP (R) or RETAINING WALL (RW).

Culvert Outlet Protection

Gabions or rock retaining walls at culvert outlets shall be designed according to RETAINING WALL (RW). No formal design is required for plunge pools at outlets. Riprap aprons at culvert outlets shall be designed as follows:

Tailwater Depth. The depth of tailwater immediately below the pipe outlet must be determined for the design capacity of the pipe. If the tailwater depth is less than half the diameter of the outlet pipe, and the receiving stream is wide enough to accept divergence of the flow, it shall be classified as a Minimum Tailwater Condition. If the tailwater depth is greater than half the pipe diameter and the receiving stream will continue to confine the flow, it shall be classified as a Maximum Tailwater Condition. Pipes which outlet onto flat areas with no defined channel may be assumed to have a Minimum Tailwater Condition.

Riprap Apron Size & D_{50} . The apron length (L_A) and the D_{50} of the riprap shall be determined from Table CP-1 according to the design flow and whether there is a minimum or maximum tailwater condition. The apron width (W) shall then be determined as:

$$W = d + 0.4 L_A$$

where d is the diameter of the culvert. If the pipe discharges directly into a well defined channel, the apron shall extend across the channel bottom and up the channel banks to an elevation one foot above the maximum tailwater depth or to the top of the bank, whichever is less. The upstream end of the apron, adjacent to the pipe, shall have a width two (2) times the diameter of the outlet pipe, or conform to pipe end section if used.

Riprap Materials. The outlet protection may be done using rock riprap or grouted riprap. Riprap shall be composed of a well-graded mixture of stone size so that 50 percent of the pieces, by weight, shall be larger than the D_{50} size determined from Table CP-1. A well-graded mixture, as used herein, is defined as a mixture composed primarily of larger stone sizes, but with a sufficient mixture of other sizes to fill the smaller voids between the stones. The diameter of the largest stone size in such a mixture shall be 1.5 times the D_{50} size. All grout for grouted riprap must be one part Portland cement for every 3 parts sand, mixed thoroughly with water.

Filter. If a filter cloth or gravel is used, it should be designed according to RIPRAP (R).

Apron Thickness. The minimum thickness of the riprap layer shall be 1.5 times the maximum stone diameter for D_{50} of 15 inches or less; and 1.2 times the maximum stone size for D_{50} greater than 15 inches.

Riprap Stone Quality. Stone for riprap shall consist of field stone or rough unhewn quarry stone. The stone shall be hard and angular and of a quality that will not disintegrate on exposure to water or weathering. The specific gravity of the individual stones shall be at least 2.5. Site rock or site boulders may be used provided it has a density of at least 150 pounds per cubic foot, and does not have any exposed steel or reinforcing bars.

Construction Specifications

Culvert Inlet Protection

1. Riprap, gabions, or rock retaining walls at culvert inlets shall be constructed according to RIPRAP (R) or RETAINING WALL (RW).
2. After installation of a culvert, examine the stream channel for the amount of debris, logs, and brushy vegetation present. In channels with large amounts of debris, consider using oversized pipes.
3. Boulders should be drystacked around the culvert inlet and up the slope to the edge of the road.

Culvert Outlet Protection

Gabions or rock retaining walls at culvert outlets shall be constructed according to RETAINING WALL (RW). Riprap aprons at culvert outlets shall be constructed according to Figure CP-2 and as follows:

1. Prepare the subgrade for the riprap to the required lines and grades. Any fill required in the subgrade shall be compacted to a density of approximately that of the surrounding undisturbed material.
2. If a pipe discharges into a well-defined channel, the channel's side slopes may not be steeper than 2:1.
3. Construct apron to the design length and width with no slope (Figure CP-2). The invert elevations must be equal at the receiving channel and the apron's downstream end. No overfall at the end of the apron is allowed. The elevation of the downstream end of the apron shall be equal to the elevation of the receiving channel or adjacent ground. The outlet protection apron shall be located so that there are no bends in the horizontal alignment.
4. Line the apron with riprap, grouted riprap, or concrete. Riprap should be the appropriate size and thickness as designed. See RIPRAP (R) for the placement of riprap.

5. If a culvert outlets at the top of cuts/fills or on slopes steeper than 10 percent one of the following two options is suggested:
- a. Transition culvert to a slope drain according to SLOPE DRAIN (SD). The slope drain shall convey storm water to the bottom of the slope where a riprap apron, as designed above, shall prevent erosion at the slope drain outlet.
 - b. Line slope below culvert outlet with a riprap channel to convey storm water to the bottom of the slope where a riprap apron, as designed above, shall prevent erosion at the bottom of the slope. The riprap channel shall be designed according to the table in the RIPRAP (R) construction specification that is based on depth of flow and slope. The riprap channel shall dip into the slope so that all water is contained within the channel, flows to the riprap outlet apron at the base of the slope, and does not spill over the sides onto unprotected soil.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Inspect for debris at the entrance to culverts and within culverts. Inspect riprap at culvert inlets for damaged or dislodged stones. The maintenance needs are usually very low for properly installed riprap aprons at culvert outlets. However, inspect for evidence of scour beneath riprap at outlet aprons or for dislodged stones. Anything that is found to reduce the effectiveness of the culvert or culvert outlet protection should be repaired immediately.

References

Keller, Gordon, and James Sherar, *Low-Volume Roads Engineering, Best Management Practices Field Guide*. United States Department of Agriculture (USDA), Forest Service, US Agency of International Development (USAID), 2005. <<http://www.blm.gov/bmp/field%20guide.htm>>

New York State Department of Environmental Conservation, *New York Guidelines for Urban Erosion and Sediment Control*. New York. Fourth Edition, 1997. <<http://www.dec.state.ny.us/website/dow/toolbox/escstandards>>

**Table CP-1
Outlet Protection Design**

Riprap Aprons for Low Tailwater (downstream flow depth < 0.5 x pipe diameter)															
Culvert Diameter	Lowest value			Intermediate values to interpolate from									Highest value		
	Q	L _A	D ₅₀	Q	L _A	D ₅₀	Q	L _A	D ₅₀	Q	L _A	D ₅₀	Q	L _A	D ₅₀
	Cfs	Ft	In	Cfs	Ft	In	Cfs	Ft	In	Cfs	Ft	In	Cfs	Ft	In
12"	4	7	2.5	6	10	3.5	9	131	6	12	16	7	14	17	8.5
15"	6.5	8	3	10	12	5	15	16	7	20	18	10	25	20	12
18"	10	9	3.5	15	14	5.5	20	17	7	30	22	11	40	25	14
21"	15	11	4	25	18	7	35	22	10	45	26	13	60	29	18
24"	21	13	5	35	20	8.5	50	26	12	65	30	16	80	33	19
27"	27	14	5.5	50	24	9.5	70	29	14	90	34	18	110	37	22
30"	36	16	6	60	25	9.5	90	33	15.5	120	38	20	140	41	24
36"	56	20	7	100	32	13	140	40	18	180	45	23	220	50	28
42"	82	22	8.5	120	32	12	160	39	17	200	45	20	260	52	26
48"	120	26	10	170	37	14	220	46	19	270	54	23	320	64	37

Riprap Aprons for High Tailwater (downstream flow depth > 0.5 x pipe diameter)															
Culvert Diameter	Lowest value			Intermediate values to interpolate from									Highest value		
	Q	L _A	D ₅₀	Q	L _A	D ₅₀	Q	L _A	D ₅₀	Q	L _A	D ₅₀	Q	L _A	D ₅₀
	Cfs	Ft	In	Cfs	Ft	In	Cfs	Ft	In	Cfs	Ft	In	Cfs	Ft	In
12"	4	8	2	6	18	2.5	9	28	4.5	12	36	7	14	40	8
15"	7	8	2	10	20	2.5	15	34	5	20	42	7.5	25	50	10
18"	10	8	2	15	22	3	20	34	5	30	50	9	40	60	11
21"	15	8	2	25	32	4.5	35	48	7	45	58	11	60	72	14
24"	20	8	2	35	36	5	50	55	8.5	65	68	12	80	80	15
27"	27	10	2	50	41	6	70	58	10	90	70	14	110	82	17
30"	36	11	2	60	42	6	90	64	11	120	80	15	140	90	18
36"	56	13	2.5	100	60	7	140	85	13	180	104	18	220	120	23
42"	82	15	2.5	120	50	6	160	75	10	200	96	14	260	120	19
48"	120	20	2.5	170	58	7	220	85	12	270	105	16	320	120	20

**Figure CP-1
Typical Inlet Protection**

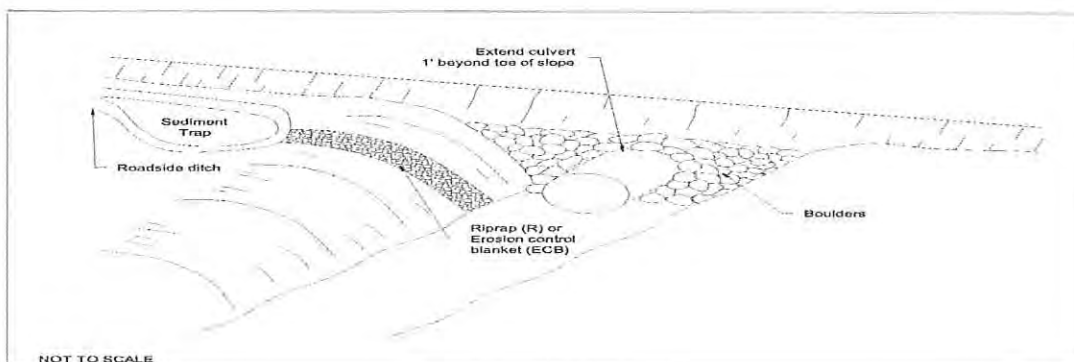
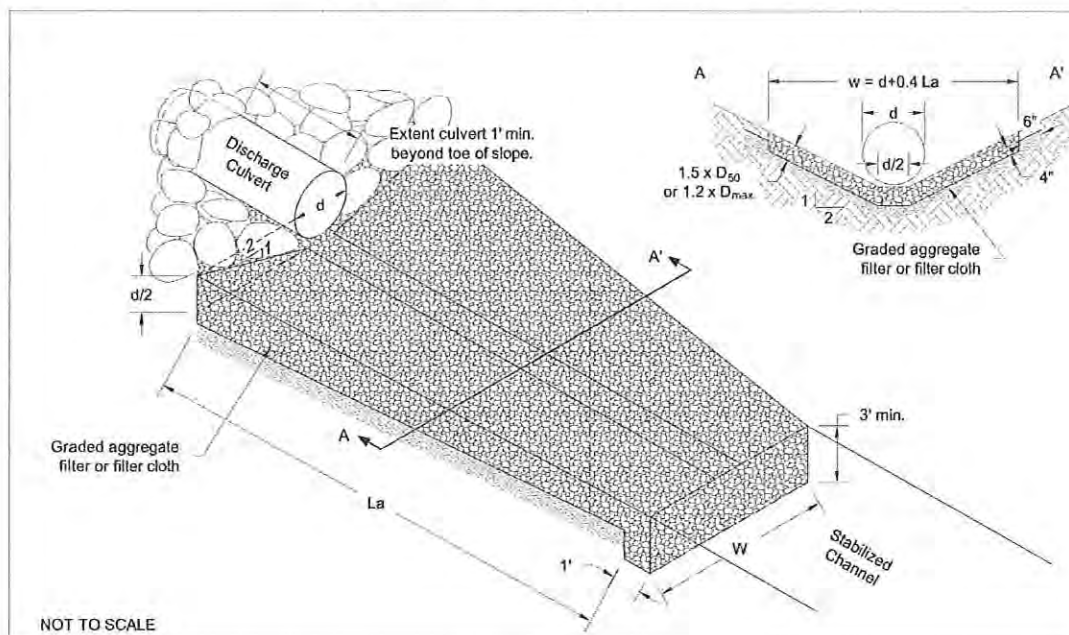


Figure CP-2
Typical Outlet Protection



Diversion (D)

EC-17



Definition

A diversion is a drainage way of parabolic or trapezoidal cross-section with a supporting ridge on the lower side that is constructed across the slope. The purpose of a diversion is to prevent off site storm runoff from entering a disturbed area, to prevent sediment laden storm runoff from leaving the construction site or disturbed area, to prevent flows from eroding slopes, and to direct sediment laden flows to a trapping device.

Applicability

Diversions may be designed for temporary or permanent use. The maximum drainage area for temporary, un-compacted diversions is two acres. For drainage areas larger than two acres but less than ten acres, the diversion should be compacted. For undisturbed drainage areas larger than ten acres, a permanent diversion may be designed to handle larger flows. Diversions may be used for the following applications:

- Upslope of cut or fill slopes to convey or divert flows away from disturbed areas.
- Downslope of cut or fill slopes to divert onsite runoff to a stabilized outlet or sediment trapping device.
- At the outer edge of a well pad to ensure that runoff remains on the pad and is diverted to a well pad detention pond, if available.
- Where runoff from higher areas has potential for causing erosion, or interfering with, or preventing the establishment of, vegetation on lower areas.

- Where the length of slopes needs to be reduced so that soil loss will be kept to a minimum.
- At the perimeter of a site or disturbed area.

Limitations

- The area around the diversion channel that is disturbed by its construction must be stabilized (with vegetation or other erosion control) so that it is not subject to similar erosion as the steep slope the channel is built to protect.
- To alleviate erosion capability, diversions must be directed into a stabilized outlet or well-vegetated area or to sediment trapping devices, where erosion sediment can settle out of the runoff before being discharged to surface waters.
- Temporary diversions should be designed to avoid crossing vehicle pathways.
- Diversions should be used with caution on soils subject to slippage.

Design Criteria

For a temporary diversion (drainage area less than 10 acres), no formal design is necessary. For a permanent diversion (drainage area larger than 10 acres) the following guidelines apply:

Location

Diversions are typically located above or below cut or fill slopes. Exact diversion location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, and the development layout. Where possible on shallow slopes, a vegetated buffer strip should be left between the edge of the cut or fill slope and the diversion. See VEGETATED BUFFER (VB).

Capacity

Peak rates of runoff values used in determining the capacity requirements shall be as outlined by TR-55, Urban Hydrology for Small Watersheds. The constructed diversion shall have capacity to carry, as a minimum, the peak discharge from a ten-year frequency rainfall event with freeboard of not less than 0.3 feet.

Cross Section

See Figure D-2 for details. The diversion channel shall be parabolic or trapezoidal in shape, if possible. The diversion shall be designed to have stable side slopes. The side slopes shall not be steeper than 2:1 and shall be flat enough to ensure ease of maintenance of the diversion and its protective vegetative cover. The ridge shall have a minimum width of four feet at the design water elevation; a minimum of 0.3 feet freeboard and a reasonable settlement factor (10%) shall be provided.

Velocity and Grade

The permissible velocity for the specific soil type will determine the maximum grade. The maximum permissible velocity for sand and silt vegetated channels is 3 ft/sec, and 5 ft/sec for clay vegetated channels. Diversions are not usually applicable below high sediment producing areas unless structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with, or before, the diversions.

Construction Specifications

General

1. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.
2. All diversions shall have uninterrupted positive grade to an outlet.
3. Each diversion must have an adequate outlet where outflow will not cause damage. Diverted runoff from a disturbed area shall be conveyed to a sediment trapping device. Diverted runoff from an undisturbed area shall outlet to a sediment trapping device or into an undisturbed stabilized area at non-erosive velocities. Vegetated outlets shall be installed before diversion construction, if needed, to ensure establishment of vegetative cover in the outlet channel.

Temporary Diversion (drainage area <10 acres)

See Figure D-1.

1. The diversion shall be excavated or shaped to line, grade, and cross section as required to meet the specified criteria. The diversion does not need to be compacted if the contributing drainage area is less than 2 acres.
2. Stabilization with vegetation is not required as long as sediment traps (see SEDIMENT TRAP [ST]) or other sediment control devices are provided.

Permanent Diversion (drainage area >10 acres)

See Figure D-2.

1. The diversion shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified herein, and be free of bank projections or other irregularities which will impede normal flow.
2. Parabolic and triangular-shaped, grass-lined channels should not have a top width of more than 30 feet. Trapezoidal, grass-lined channels may not have a bottom width of more than 15 feet unless there are multiple or divided waterways, they have a riprap center, or other methods of controlling the meandering of low flows are provided.

3. If grass-lined channels have a base flow, a stone center or subsurface drain or another method for managing the base flow must be provided.
4. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the complete diversion.
5. All earth removed and not needed in construction shall be spread or disposed of on the well pad side of the diversion so that it will not interfere with the functioning of the diversion.
6. Immediately after the ridge and channel are constructed, they must be seeded or hydro-seeded and mulched or covered with erosion blanketing according to REVEGETATION (RV) and MULCHING (M) or EROSION CONTROL BLANKET (ECB) along with any disturbed areas that drain into the diversion.
 - a. For design velocities less than 3.5 ft/sec, seeding and mulching may be used for establishment of the vegetation. It is recommended that, when conditions permit, temporary diversions or other means should be used to prevent water from entering the diversion during the establishment of the vegetation.
 - b. For design velocities or more than 3.5 ft/sec, the diversion shall be stabilized with seeding protected by Jute or Excelsior matting, or with seeding and mulching including temporary diversion of the water until the vegetation is established.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Channels should be cleared of sediment, repairs made when necessary, and seeded areas reseeded if a vegetative cover is not established. Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment yielding areas are in the drainage area above the diversion. Establish necessary cleanout requirements. Redistribute sediment as necessary to maintain the capacity of the diversion.

Removal

Temporary and un-compacted diversions shall remain in place only until the disturbed areas are permanently stabilized. Permanent diversions shall remain in place until final reclamation.

References

Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February, 2003.

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/con_site.cfm>

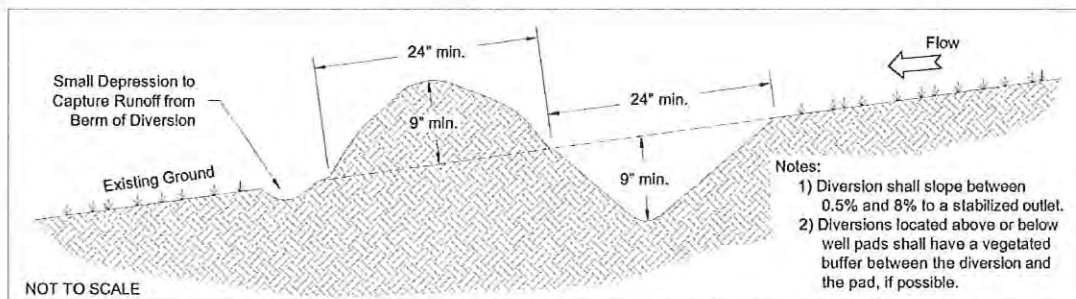
New York State Department of Environmental Conservation, *New York Guidelines for Urban Erosion and Sediment Control*. New York. Fourth Edition, 1997.

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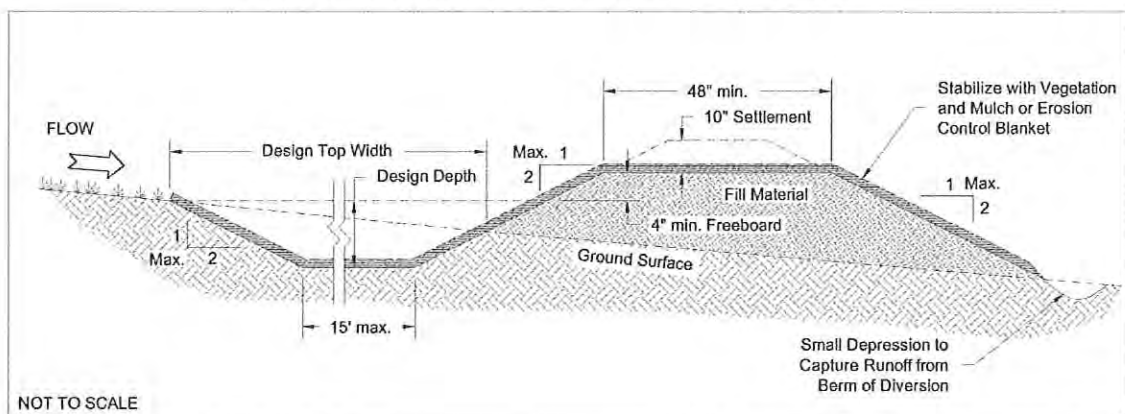
United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), *Field Office Technical Guide*. 2002.

<www.nrcs.usda.gov/technical/efotg>

**Figure D-1
Temporary Diversion Installation**



**Figure D-2
Permanent Diversion Installation**



Drainage Dip (DD)

EC-18



Description

Drainage dips intercept and remove surface water from the road and shoulders before the combination of water volume and velocity begins to erode the surface materials. Drainage dips are constructed diagonally across and as part of the road surface, and will pass slow traffic while dispersing surface water.

Applicability

Drainage dips may be used in the following applications:

- To move water off the road surface efficiently and economically.
- In place of a culvert, which is costly and susceptible to plugging or failure.
- On low volume, low to moderate speed roads (10-35 mph) with grades less than 12%.

Limitations

- Size limited by the safe passage of trucks and equipment
- May cause concentrated flows from sheet flows
- Require vegetative cover or other filter at discharge point

Design Criteria

No formal design required.

Construction Specifications

See Figure DD-1.

1. Construct rolling dips deep enough to provide adequate drainage, angled 0-25 degrees from perpendicular to the road, with a 3-5% outslope, and long enough (50 to 200 feet) to pass vehicles and equipment.
2. In soft soils, armor the mound and dip with gravel or rock, as well as the outlet of the dip.
3. Spacing of drainage dips depends upon local conditions such as soil material, grade, and topography. See Table DD-1 for recommended maximum distances between drainage dips.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Inspections should pay close attention to discharge points.

References

Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

Keller, Gordon, and James Sherar, *Low-Volume Roads Engineering, Best Management Practices Field Guide*. United States Department of Agriculture (USDA), Forest Service, US Agency of International Development (USAID), 2005. <<http://www.blm.gov/bmp/field%20guide.htm>>

Maine Department of Conservation, *Best Management Practices for Forestry: Protecting Maine's Water Quality*. Maine Forest Service, Forest Policy and Management Division. Augusta, Maine. 2004.
<http://www.state.me.us/doc/mfs/pubs/pdf/bmp_manual/bmp_manual.pdf>

United States Department of the Interior and United States Department of Agriculture. *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development "Gold Book"*. BLM/WO/ST-06/021+3071. Bureau of Land Management (BLM). Denver, Colorado. Fourth Edition, 2006.

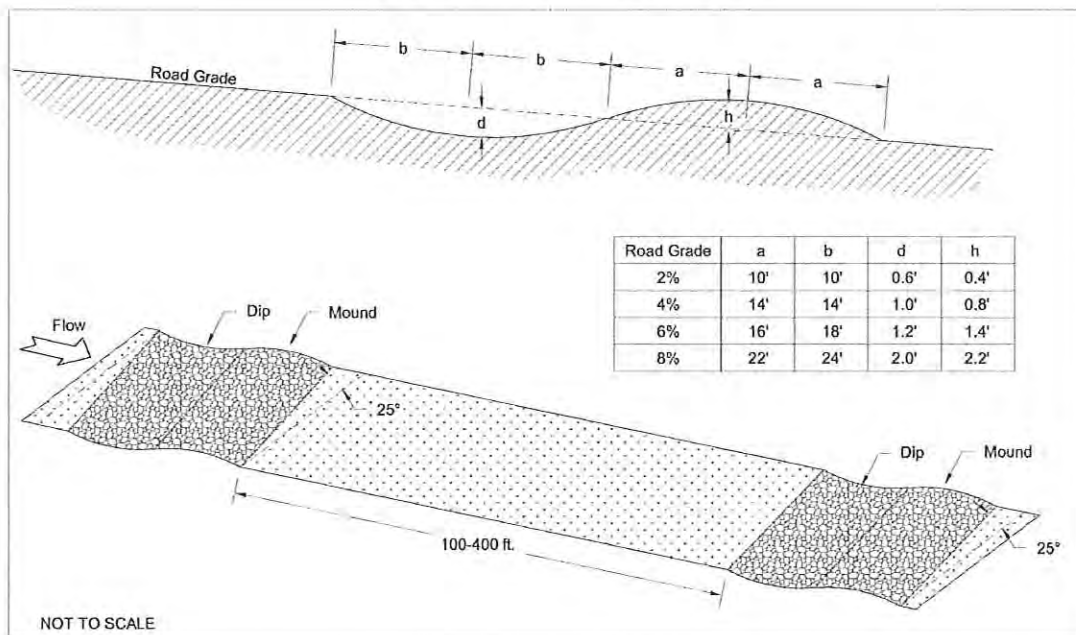
Table DD-1
Maximum Distance between Drainage Dips

Road Grade, %	Low to Non-Erosive Soils ¹	Erosive Soils ²
0 - 3	400'	200'
4 - 6	300'	160'
7 - 9	250'	130'
10 - 12	200'	110'
12+	160'	100'

¹Low Erosion Soils = Coarse Rocky Soils, Gravel, and Some Clay

²High Erosion Soils = Fine, Friable Soils, Silt, Fine Sands

Figure DD-1
Typical Drainage Dip





Description

Riprap is a permanent, erosion-resistant layer made of stones or boulders. It is intended to stabilize areas subject to erosion and protect against scour of the soil caused by concentrated, high velocity flows.

Applicability

Riprap can be used for areas subject to erosion or weathering, particularly where conditions prohibit the establishment of revegetation or where flow velocities exceed 5 ft/sec. Riprap may be used in the following applications:

- Cut-and-fill slopes
- Channel side slopes and/or bottoms
- Inlets and outlets to culverts, slope drains, and sediment traps
- Roadside ditches

Limitations

Riprap is limited by steepness of slope, because slopes greater than 1.5:1 have potential riprap loss due to erosion and sliding. When working within flowing streams, measures should be taken to prevent excessive turbidity and erosion during construction. Bypassing base flows or temporarily blocking base flows are two possible methods.

Design Criteria

Gradation

A well-graded mixture of rock sizes should be used instead of one uniform size (with the exception of dry stacking boulders). 50% by weight should be larger than the specified design size. The diameter of the largest stone size in such a mixture should be 1.5 times the d50 size with smaller sizes graded down to one inch. When dry

stacking up a slope, boulders may be uniform in size or may get gradually smaller as the boulders are placed up the slope.

Quality

Riprap must be durable so that freeze/thaw cycles do not decompose it in a short time. They should be angular and not subject to breaking down when exposed to water or weathering. The specific gravity should be at least 2.5.

Size

The sizes of stones used for riprap protection are determined by purpose and specific site conditions:

1. **Slope Stabilization.** Riprap stone for slope stabilization not subject to flowing water should be sized for the proposed grade. The gradient of the slope to be stabilized should be less than the natural angle of repose of the stone selected. Angles of repose of riprap stones may be estimated from Figure R-1. Riprap used for surface stabilization of slopes does not add significant resistance to sliding or slope failure and should not be considered a retaining wall. Slopes approaching 1.5:1 may require special stability analysis. The inherent stability of the soil must be satisfactory before riprap is used for surface stabilization.
2. **Outlet Protection.** Design criteria for sizing stone and determining dimensions of riprap aprons are presented in CULVERT PROTECTION (CP).
3. **Stream bank Protection.** If the shear stress is estimated, riprap stone for stream bank protection can be selected from the gradations in Table R-1, below. The shear stress can be estimated from the depth of flow and the channel slope (see note for Table R-1). The riprap should extend two feet below the channel bottom and be keyed into the bank both at the upstream end and downstream end of the proposed work or reach.

Filter material

Filter material is sometimes used between riprap and the underlying soil surface to prevent soil from moving through the riprap. Filter cloth material or a layer of sand and/or gravel is usually used for the filter.

The design of a sand/gravel filter blanket is based on the ratio of particle size in the overlying filter material to that of the base material in accordance with the criteria below. Multiple layers (each a minimum of 6 inches thick) may be designed to affect a proper filter if necessary. A sand/gravel filter blanket should have the following relationship for a stable design:

d15 filter
 $d_{85} \text{ base} \leq 5$

d15 filter
 $5 < d_{50} \text{ base} \leq 40$

d50 filter
 $d_{50} \text{ base} \leq 40$

The design of a synthetic filter fabric, which may be used with or in place of gravel filters, is based upon the following particle size relationships:

1. Filter fabric covering a base containing 50% or less by weight of fine particles (#200 sieve size):
 - a. d85 base (mm)
 $\text{EOS} * \text{filter fabric (mm)} > 1$
 - b. total open area of filter fabric should not exceed 36 %
2. Filter fabric covering other soils:
 - a. EOS is no larger than 0.21 mm (#70 sieve size)
 - b. total open area of filter fabric should not exceed 10%

*EOS - Equivalent opening size compared to a U.S. standard sieve size

No filter fabric should have less than 4% open area or an EOS less than U.S. Standard Sieve #100 (0.15 mm). The permeability of the fabric must be greater than that of the soil. The fabric may be made of woven or non-woven monofilament yarns and should meet the following minimum requirements:

Thickness 20-60 mils
Grab strength 90-120 lbs
Conform to ASTM D-1682 or ASTM D-177

Construction Specifications

See Figure R-2 for riprap slope stabilization and stream bank protection. See Figure R-3 for dry stacking boulders. See SEDIMENT TRAP (ST) for a detail of a riprap lined channel leading into a sediment trap. For culvert outlet protection, construct according to CULVERT PROTECTION (CP).

1. **Subgrade Preparation.** Prepare the subgrade for riprap to the required lines and grades shown on the plans. Compact any fill required in the subgrade to a density approximating that of the undisturbed material or overfill depressions with riprap. Remove brush, trees, stumps, and other objectionable material. Cut the subgrade sufficiently deep so that the

finished grade of the riprap will be at the elevation of the surrounding area. Channels should be excavated sufficiently to allow placement of the riprap in a manner such that the finished inside dimensions and grade of the riprap meet design specifications.

2. **Sand/gravel filter blanket.** If using a granular filter, spread filter stone in a uniform layer to the specified depth. Where more than one layer of filter material is used, spread the layers with minimal mixing.
3. **Synthetic filter fabric.** If using a filter fabric, place the cloth directly on the prepared foundation. Where large stones are to be placed, a 4-inch layer of fine sand or gravel is recommended to protect the filter cloth. Filter fabric is not recommended as a filter on slopes steeper than 2 horizontal to 1 vertical.
4. **Stone placement.** Place riprap so that it forms dense, well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement. Place riprap to its full thickness in one operation. Do not place riprap by dumping through chutes or other methods that cause segregation of stone sizes. If a filter is used, be careful not to dislodge the underlying base filter or damage the filter cloth when placing the stones. If damage occurs, remove the riprap and repair filter.

The toe of the riprap should be keyed into a stable foundation at its base as shown in Figure R-2 if required for slope stabilization and stream bank protection. The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve proper distribution of stone sizes to produce a relatively smooth, uniform surface. The finished grade of the riprap should blend with the surrounding area.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). If riprap has been damaged or dislodged, repairs should be made to prevent a progressive failure. If repairs are needed repeatedly at one location, the site should be evaluated to determine if the original design conditions have changed. Channel obstructions such as trees and sediment bars can change flow patterns and cause erosive forces that may damage riprap. Control of weed and brush growth may be needed in some locations.

Removal

Riprap is generally not removed.

References

Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February, 2003.

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/con_site.cfm>

New York State Department of Environmental Conservation, *New York Guidelines for Urban Erosion and Sediment Control*. New York. Fourth Edition, 1997.

<<http://www.dec.state.ny.us/website/dow/toolbox/escstandards>>

Table R-1
Riprap Gradations

Unit shear stress (lb/ft ²)	D ₅₀	d _{max}	Minimum blanket thickness (inches)
0.67	2	4	6
2	6	9	14
3	9	14	20
4	12	18	27
5	15	22	32
6	18	27	32
7.8	21	32	38
8	24	36	43

Unit shear stress calculated as $T = y \cdot d \cdot s$ where:

T = shear stress in lb/ft²

y = unit weight of water, 62.4 lb/ft³

d = flow depth in ft

s = channel gradient in ft/ft

Figure R-1
Angles of Repose of Riprap Stones

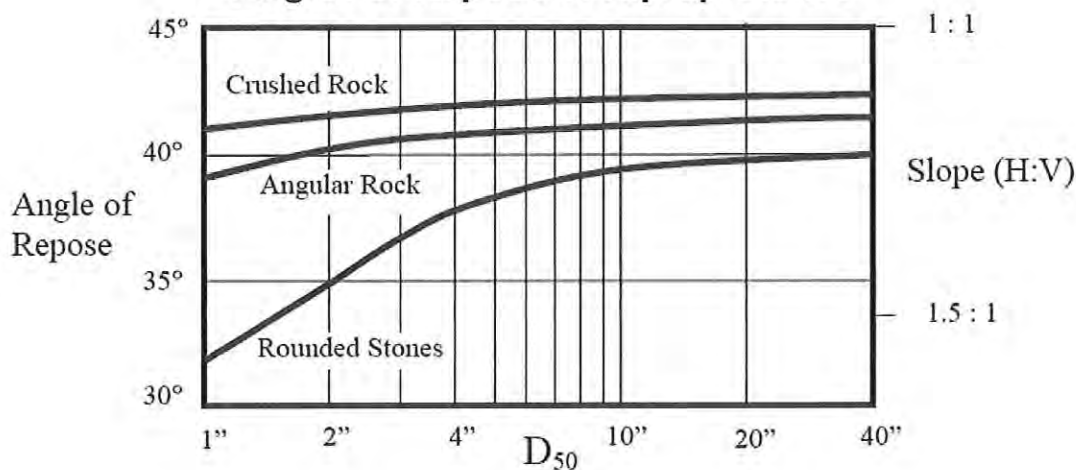


Figure R-2
Typical Riprap Slope Protection Detail

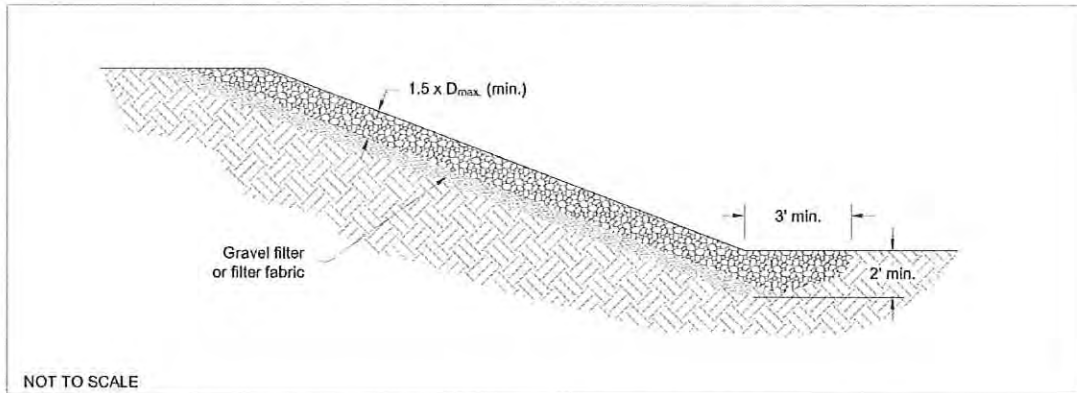
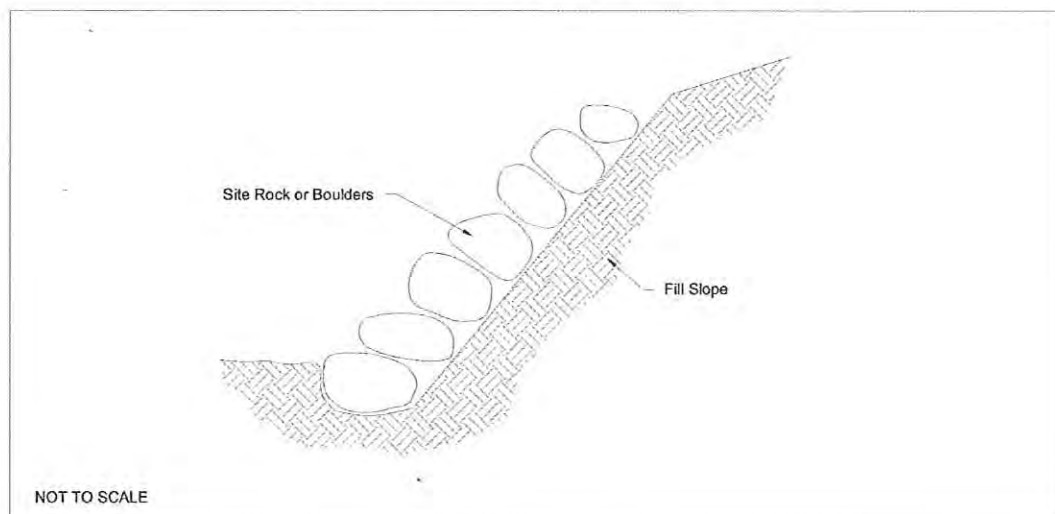


Figure R-3
Typical Boulder Drystack Detail



Roadside Ditches (RSD) and Turnouts (TO)

EC-20



Description

Roadside ditches are channels constructed parallel to roads. The ditches convey concentrated runoff of surface water from roads and surrounding areas to a stabilized outlet. Turnouts (also called wing ditches) are extensions of road-side ditches. Turnouts effectively remove run-off water from the roadside ditch into well-stabilized areas before it reaches a waterway.

Applicability

- Roadside ditches should be used for all roads built on sloping topography and with either an insloped or a crowned design.
- Ditch turnouts should be used as much as possible but their best use may be on slopes longer than 150 ft or greater than 5%, as conditions allow.
- Turnouts are applicable where fairly flat naturally vegetated areas exist at intervals by the roadside.

Limitations

- If these structures are not installed correctly they may become a source of erosion.
- Road-side ditches do not necessarily filter sediment from runoff.
- Turnouts should be on gradual slopes only.

- Turnouts require vegetative cover or other filter at the discharge point.
- Turnouts only work well if small volumes of runoff drain into the turnout. Turnouts should only receive runoff from the road and ditch surface, not from large, uphill watersheds.

Design Criteria

No formal design is required.

Construction Specifications

Roadside Ditches

1. Roadside ditches should be constructed with no projections of roots, stumps, rocks, or similar debris.
2. Excavate ditches along roadside to a width and depth that can handle expected flows according to Figure RSD-1.
3. All ditches shall have uninterrupted positive grade to an outlet. Slope ditch so that water velocities do not cause excessive erosion, but no less than 0.5%. If steep slopes and high velocities exist, use check dams to slow runoff and catch sediment.
4. To control erosion and collect sediment, construct aggregate check dams according to Figure CD-1 of CHECK DAM (CD).
5. All ditches shall convey runoff to a sediment trapping device such as a SEDIMENT TRAP (ST) or an undisturbed, well vegetated and stabilized area at non-erosive velocity.
6. If necessary, stabilize ditches with RIPRAP (R) or EROSION CONTROL BLANKET (ECB).

Turnouts

1. Use turnouts wherever possible and on undisturbed soil.
2. Turnouts should be on gradual slopes only and should slope gradually down from bottom of road-side ditch.
3. Angle turnout at approximately 30 degrees to the road-side ditch.
4. Discharge turnout into well-vegetated area or install a secondary control such as a wattle, sediment trap, or silt fence. As a good Rule of Thumb, the vegetated outlet area should be a minimum of one half the size of the total drainage area draining into it. If well-vegetated outlet areas are not available, use culverts or other controls to direct runoff to a stabilized area.
5. Space turnouts according to slope as indicated on Figure TO-1.

6. Turnouts only work well if small volumes of runoff drain into the turnout. Turnouts should only receive runoff from the road and ditch surface, not from large, uphill watersheds.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Road ditches and turnouts should be inspected for any signs of channelization, and repaired as necessary. Structures will fail if water exits in channelized flow. Also inspect for sediment buildup at the outlet and at aggregate check dams and remove if necessary.

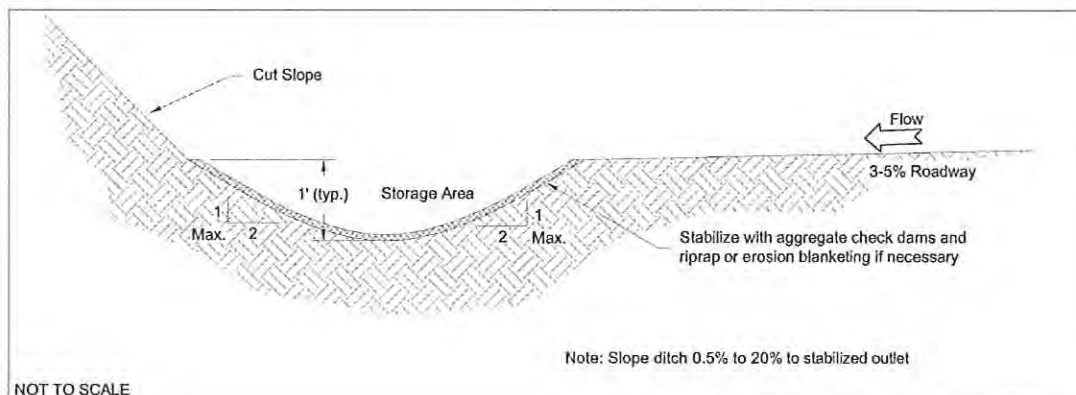
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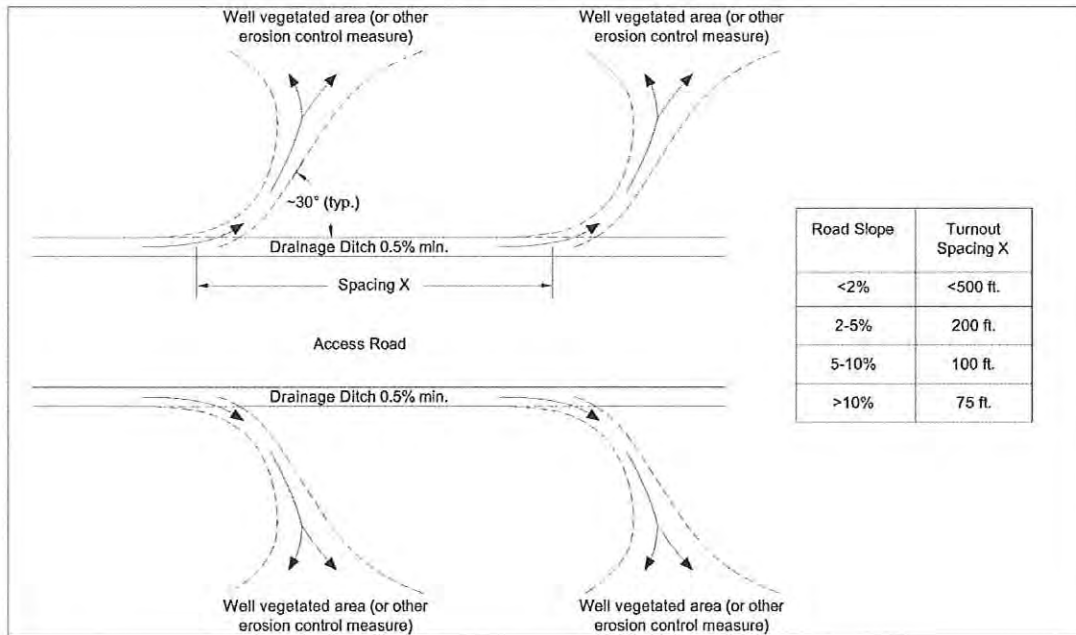
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**Figure RSD-1
Roadside Ditch Installation**



**Figure TO-1
Turnout Layout**



Water Bar (WB)

EC-21



Description

A water bar is an earthen ridge, or ridge and channel, constructed diagonally across a sloping road, trail, or disturbed area that is subject to erosion. Water bars are normally used for drainage and erosion protection of closed, blocked, or infrequently used roads to limit the accumulation of erosive volumes of water by diverting surface runoff at pre-designed intervals.

Applicability

Water bars are applicable where runoff protection is needed to prevent erosion on sloping access right-of-ways or long, narrow sloping areas generally less than 100 feet in width. This is a practice that is often used on limited-use roads, trails and firebreaks. It is an excellent method of retiring roads and trails as well as abandoned roads where surface water runoff may cause erosion of exposed mineral soil.

Limitations

- Not for use on concentrated flows
- May cause concentrated flows from sheet flow
- Requires vegetative cover or other filter at discharge point

Design Criteria

No formal design is required.

Construction Specifications

See Figure WB-1.

1. Clear the base for the ridge before placing fill.
2. Track the ridge to compact it to the design cross section.
3. Install the water bar according to Figure WB-1 as soon as the base is cleared and graded. The positive grade shall not exceed 2 percent.
4. Vehicle crossings shall be stabilized with gravel. Exposed areas shall be immediately seeded and mulched.
5. Extend the water bar inlet and outlet 1 foot or more beyond the side of the road, trail, or disturbed area to keep the diverted water from re-entering the area.
6. Space the water bars according to Table WB-1.
7. Locate the outlet on an undisturbed area. Field spacing shall be adjusted to use the most stable outlet areas. Outlet protection will be provided when natural areas are not adequate.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Inspect water bars for erosion damage and sediment. Check outlet areas and make repairs as needed to restore operation.

Removal

If water bars are used on a closed or blocked road, they should be removed prior to re-opening of the road. Water bars on infrequently used roads or other disturbed areas may remain in place as long as necessary.

References

Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

Keller, Gordon, and James Sherar, *Low-Volume Roads Engineering, Best Management Practices Field Guide*. United States Department of Agriculture (USDA), Forest Service, US Agency of International Development (USAID), 2005. <<http://www.blm.gov/bmp/field%20guide.htm>>

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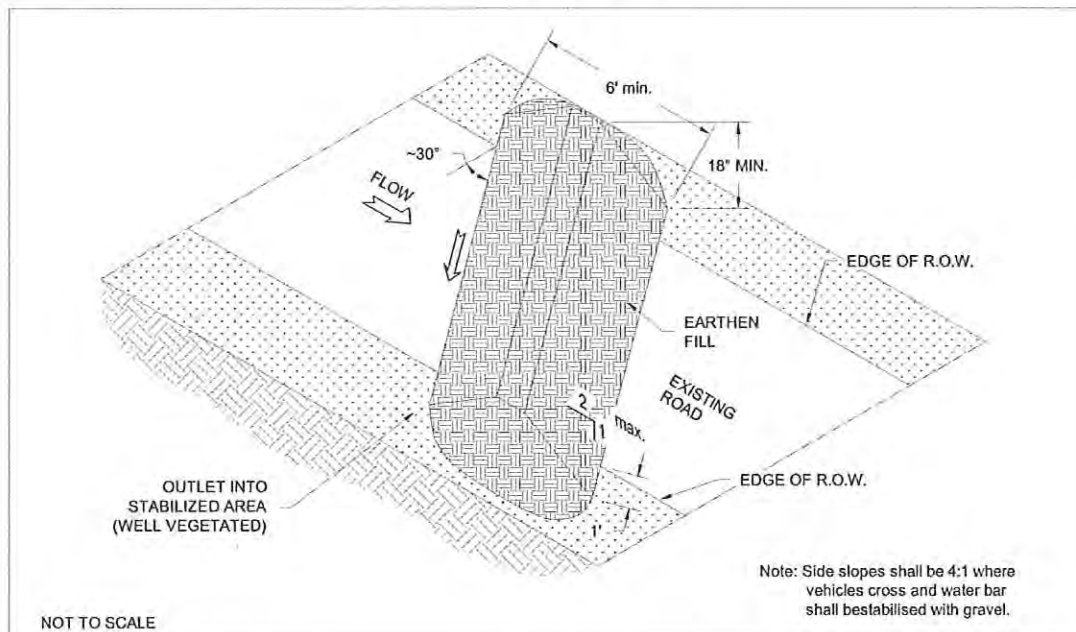
**Table WB-1
Water Bar Spacing**

Road/Trail Grade (%)	Low to Non-Erosive Soils ¹	Erosive Soils ²
0 - 5	245'	130'
6 - 10	200'	100'
11 - 15	150'	65'
16 - 20	115'	50'
21 - 30	100'	40'
31+	50'	30'

¹Low Erosion Soils = Coarse Rocky Soils, Gravel, and Some Clay

²High Erosion Soils = Fine, Friable Soils, Silt, Fine Sands

**Figure WB-1
Water Bar Installation**



Berm (B)

EC-22



Description

A berm is a ridge of compacted soil located at the top or base of a sloping disturbed area to contain or divert surface runoff. Berms may be constructed from either excavated topsoil or subsoil.

The purpose of a berm is to control runoff velocity, divert onsite surface runoff to a sediment trapping device, and/or divert clean water away from disturbed areas.

Applicability

Berms are usually appropriate for drainage basins smaller than five acres, but with modifications they can be capable of servicing areas as large as ten acres.

Berms are applicable for the following applications:

- At the perimeter of a well pad (particularly the outer edge) to ensure that runoff remains on the pad and is diverted to a well pad detention pond, if available.
- Along the outside shoulder of an insloped road to ensure that runoff from the roadway drains inward and to protect the fill slope from continual disturbances during road blading and maintaining. See LAND GRADING (LG).
- Upslope of cut or fill slopes to divert flows away from disturbed areas.
- Downslope of cut or fill slopes to divert onsite runoff to a stabilized outlet or sediment trapping device, although diversions are more commonly used for this application. See DIVERSION (D).

Limitations

- Berms may erode if not properly compacted and stabilized with vegetation. Berms which are adjacent to concentrated flows will require erosion blanketing.
- If a berm crosses a vehicle roadway or entrance, its effectiveness can be reduced. Wherever possible, berms should be designed to avoid crossing vehicle pathways.

Design Criteria

No formal design is required.

Construction Specifications

1. Prior to berm construction, remove all trees, brush, stumps and other objects in the path of the berm and till the base of the berm before laying the fill. Fill may consist of topsoil or subsoil excavated during the construction of nearby roads or well pads. If fill material is excavated adjacent to berm, following the specification for DIVERSION (D).
2. Construct general site perimeter berms according to Figure B-1 Type A for the appropriate drainage area. For points where vehicles will cross the berm, the side slope should be no steeper than 3:1 and the mound may be constructed of gravel rather than soil. This will prolong the life of the berm and increase effectiveness at the point of vehicle crossing.
3. For well pad perimeter installation construct according to Figure B-1 Type B. The pad side of the berm should be sloped at 1.5:1 to help prevent vehicles from backing over the edge of the pad.
4. For roadside berms, construct according to Figure B-1 Type C.
5. To remain effective, berms should be compacted with tracked equipment, if possible.
6. All berms shall have positive drainage to a stabilized outlet so that runoff does not collect in ponds on the upslope side of the berm, but instead flows along the berm until it reaches a stabilized outlet. Field location should be adjusted as needed. Stabilized outlet may be a well-vegetated area, a well pad detention pond, or a sediment control such as a silt fence or sediment trap where sediment can settle out of the runoff before being discharged to surface waters.
7. If the expected life span of the berm is greater than 15 days, it is strongly recommended that the berm be stabilized with vegetation or an erosion control blanket immediately after construction. Stabilization is required

where concentrated flows are expected. See Table B-1 for recommended stabilization methods for berms on various slopes.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Berms should be inspected for evidence of erosion or deterioration to ensure continued effectiveness. Berms should also be maintained at the original height. Any decrease in height due to settling or erosion, which impacts the effectiveness of the BMP, should be repaired immediately.

Removal

Berms should remain in place and in good condition until all upslope disturbed areas are permanently stabilized. There is no need to formally remove the berm on completion of stabilization until interim or final reclamation.

References

Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February, 2003.

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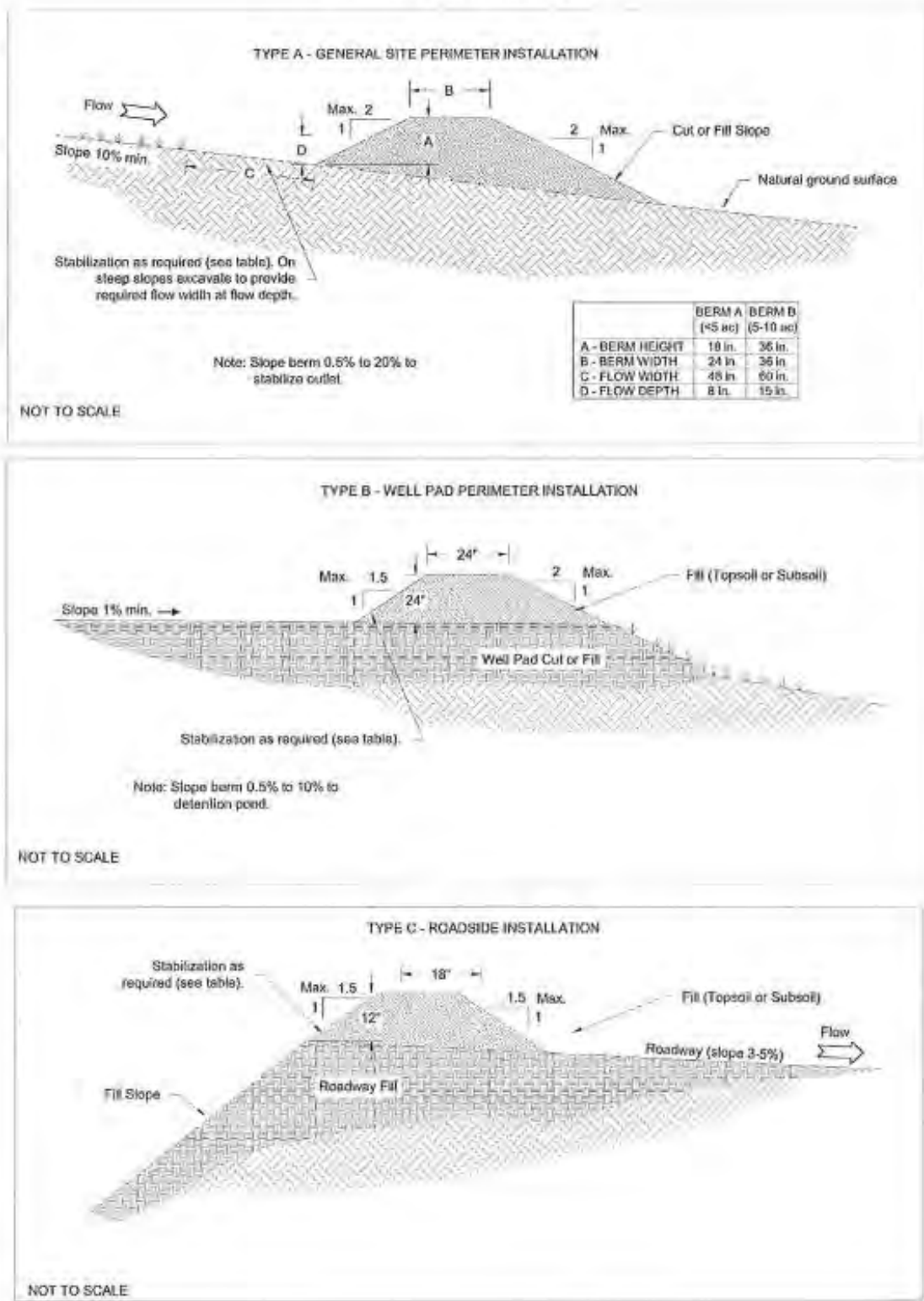
Table B-1
Berm Stabilization

Treatment Type	Channel Grade ¹	A (<5 Ac.)	B (5-10 Ac)
1	0.5-3.0%	Seed & Straw Mulch	Seed & Straw Mulch
2	3.0-5.0%	Seed & Straw Mulch	Seed and cover with erosion control blanket, or lined with 2-inch stone
3	5.0-8.0%	Seed and cover with erosion control blanket, or line with 2-inch stone	Line with 4 to 8-inch stone or rock ²
4	8.0-20.0%	Line with 4 to 8-inch or stone or rock ²	Engineering Design

¹In highly erodible soils, as defined by the local approving agency, refer to the next higher slope grade for type of stabilization.

²Site rock, if available, shall be broken into the required size.

Figure B-1
Berm Installation



Description

Concrete waste management involves designating and properly managing a specific area of the construction site as a concrete washout area. A concrete washout area can be created using one of several approaches designed to receive wash water from washing of tools and concrete mixer chutes, liquid concrete waste from dump trucks, mobile batch mixers, or pump trucks. Three basic approaches are available: excavation of a pit in the ground, use of an above ground storage area, or use of prefabricated haul-away concrete washout containers. Surface discharges of concrete washout water from construction sites are prohibited.



Photograph CWA-1. Example of concrete washout area. Note gravel tracking pad for access and sign.

Appropriate Uses

Concrete washout areas must be designated on all sites that will generate concrete wash water or liquid concrete waste from onsite concrete mixing or concrete delivery.

Because pH is a pollutant of concern for washout activities, when unlined pits are used for concrete washout, the soil must have adequate buffering capacity to result in protection of state groundwater standards; otherwise, a liner/containment must be used. The following management practices are recommended to prevent an impact from unlined pits to groundwater:

- The use of the washout site should be temporary (less than 1 year), and
- The washout site should be not be located in an area where shallow groundwater may be present, such as near natural drainages, springs, or wetlands.

Design and Installation

Concrete washout activities must be conducted in a manner that does not contribute pollutants to surface waters or stormwater runoff. Concrete washout areas may be lined or unlined excavated pits in the ground, commercially manufactured prefabricated washout containers, or aboveground holding areas constructed of berms, sandbags or straw bales with a plastic liner.

Although unlined washout areas may be used, lined pits may be required to protect groundwater under certain conditions.

Do not locate an unlined washout area within 400 feet of any natural drainage pathway or waterbody or within 1,000 feet of any wells or drinking water sources. Even for lined concrete washouts, it is advisable to locate the facility away from waterbodies and drainage paths. If site constraints make these

Concrete Washout Area	
Functions	
Erosion Control	No
Sediment Control	No
Site/Material Management	Yes

setbacks infeasible or if highly permeable soils exist in the area, then the pit must be installed with an impermeable liner (16 mil minimum thickness) or surface storage alternatives using prefabricated concrete washout devices or a lined aboveground storage area should be used.

Design details with notes are provided in Detail CWA-1 for pits and CWA-2 for aboveground storage areas. Pre-fabricated concrete washout container information can be obtained from vendors.

Maintenance and Removal

A key consideration for concrete washout areas is to ensure that adequate signage is in place identifying the location of the washout area. Part of inspecting and maintaining washout areas is ensuring that adequate signage is provided and in good repair and that the washout area is being used, as opposed to washout in non-designated areas of the site.

Remove concrete waste in the washout area, as needed to maintain BMP function (typically when filled to about two-thirds of its capacity). Collect concrete waste and deliver offsite to a designated disposal location.

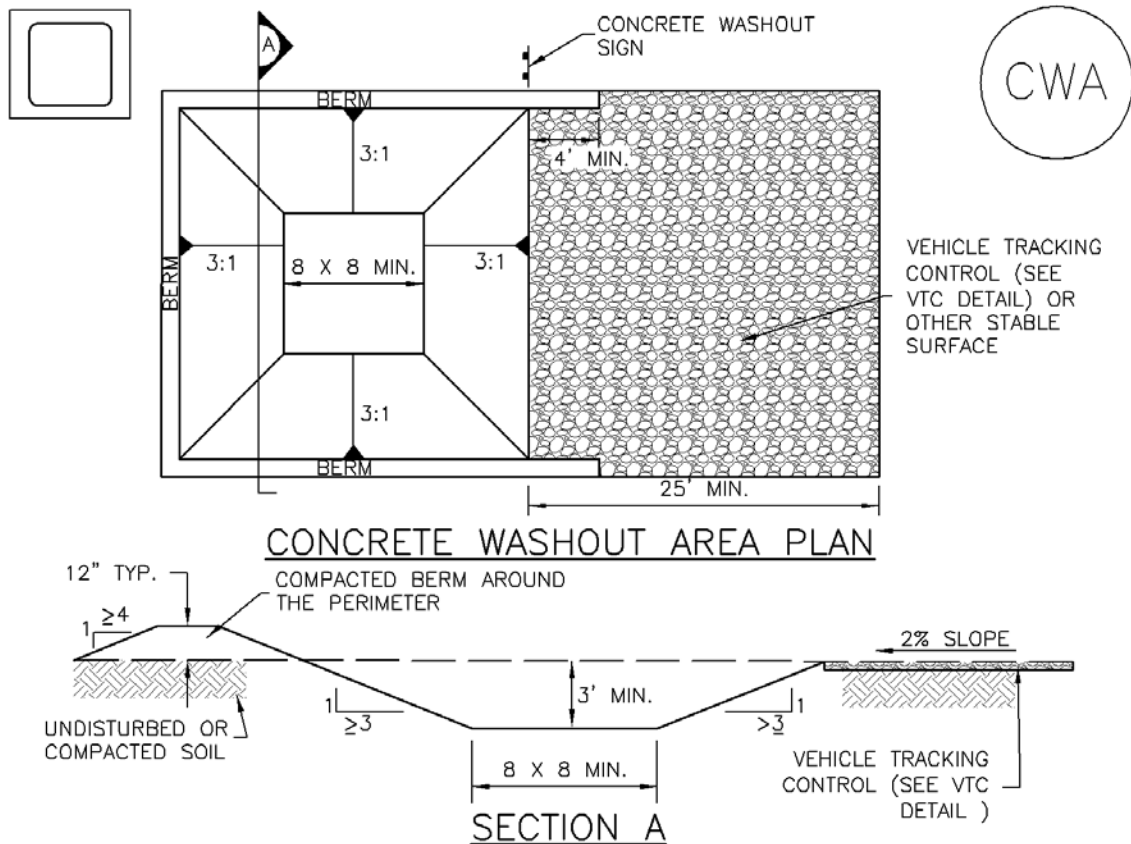
Upon termination of use of the washout site, accumulated solid waste, including concrete waste and any contaminated soils, must be removed from the site to prevent on-site disposal of solid waste. If the wash water is allowed to evaporate and the concrete hardens, it may be recycled.



Photograph CWA-2. Prefabricated concrete washout. Photo courtesy of CDOT.



Photograph CWA-3. Earthen concrete washout. Photo courtesy of CDOT.



CWA-1. CONCRETE WASHOUT AREA

CWA INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
-CWA INSTALLATION LOCATION.
2. DO NOT LOCATE AN UNLINED CWA WITHIN 400' OF ANY NATURAL DRAINAGE PATHWAY OR WATERBODY. DO NOT LOCATE WITHIN 1,000' OF ANY WELLS OR DRINKING WATER SOURCES. IF SITE CONSTRAINTS MAKE THIS INFEASIBLE, OR IF HIGHLY PERMEABLE SOILS EXIST ON SITE, THE CWA MUST BE INSTALLED WITH AN IMPERMEABLE LINER (16 MIL MIN. THICKNESS) OR SURFACE STORAGE ALTERNATIVES USING PREFABRICATED CONCRETE WASHOUT DEVICES OR A LINED ABOVE GROUND STORAGE ARE SHOULD BE USED.
3. THE CWA SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE.
4. CWA SHALL INCLUDE A FLAT SUBSURFACE PIT THAT IS AT LEAST 8' BY 8' SLOPES LEADING OUT OF THE SUBSURFACE PIT SHALL BE 3:1 OR FLATTER. THE PIT SHALL BE AT LEAST 3' DEEP.
5. BERM SURROUNDING SIDES AND BACK OF THE CWA SHALL HAVE MINIMUM HEIGHT OF 1'.
6. VEHICLE TRACKING PAD SHALL BE SLOPED 2% TOWARDS THE CWA.
7. SIGNS SHALL BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE CWA, AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CWA TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS.
8. USE EXCAVATED MATERIAL FOR PERIMETER BERM CONSTRUCTION.

CWA MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. THE CWA SHALL BE REPAIRED, CLEANED, OR ENLARGED AS NECESSARY TO MAINTAIN CAPACITY FOR CONCRETE WASTE. CONCRETE MATERIALS, ACCUMULATED IN PIT, SHALL BE REMOVED ONCE THE MATERIALS HAVE REACHED A DEPTH OF 2'.

5. CONCRETE WASHOUT WATER, WASTED PIECES OF CONCRETE AND ALL OTHER DEBRIS IN THE SUBSURFACE PIT SHALL BE TRANSPORTED FROM THE JOB SITE IN A WATER-TIGHT CONTAINER AND DISPOSED OF PROPERLY.

6. THE CWA SHALL REMAIN IN PLACE UNTIL ALL CONCRETE FOR THE PROJECT IS PLACED.

7. WHEN THE CWA IS REMOVED, COVER THE DISTURBED AREA WITH TOP SOIL, SEED AND MULCH OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD).

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Stockpile management includes measures to minimize erosion and sediment transport from soil stockpiles.

Appropriate Uses

Stockpile management should be used when soils or other erodible materials are stored at the construction site. Special attention should be given to stockpiles in close proximity to natural or manmade storm systems.



Photograph SP-1. A topsoil stockpile that has been partially revegetated and is protected by silt fence perimeter control.

Design and Installation

Locate stockpiles away from all drainage system components including storm sewer inlets. Where practical, choose stockpile locations that that will remain undisturbed for the longest period of time as the phases of construction progress. Place sediment control BMPs around the perimeter of the stockpile, such as sediment control logs, rock socks, silt fence, straw bales and sand bags. See Detail SP-1 for guidance on proper establishment of perimeter controls around a stockpile. For stockpiles in active use, provide a stabilized designated access point on the upgradient side of the stockpile.

Stabilize the stockpile surface with surface roughening, temporary seeding and mulching, erosion control blankets, or soil binders. Soils stockpiled for an extended period (typically for more than 60 days) should be seeded and mulched with a temporary grass cover once the stockpile is placed (typically within 14 days). Use of mulch only or a soil binder is acceptable if the stockpile will be in place for a more limited time period (typically 30-60 days). Timeframes for stabilization of stockpiles noted in this fact sheet are "typical" guidelines. Check permit requirements for specific federal, state, and/or local requirements that may be more prescriptive.

Stockpiles should not be placed in streets or paved areas unless no other practical alternative exists. See the Stabilized Staging Area Fact Sheet for guidance when staging in roadways is unavoidable due to space or right-of-way constraints. For paved areas, rock socks must be used for perimeter control and all inlets with the potential to receive sediment from the stockpile (even from vehicle tracking) must be protected.

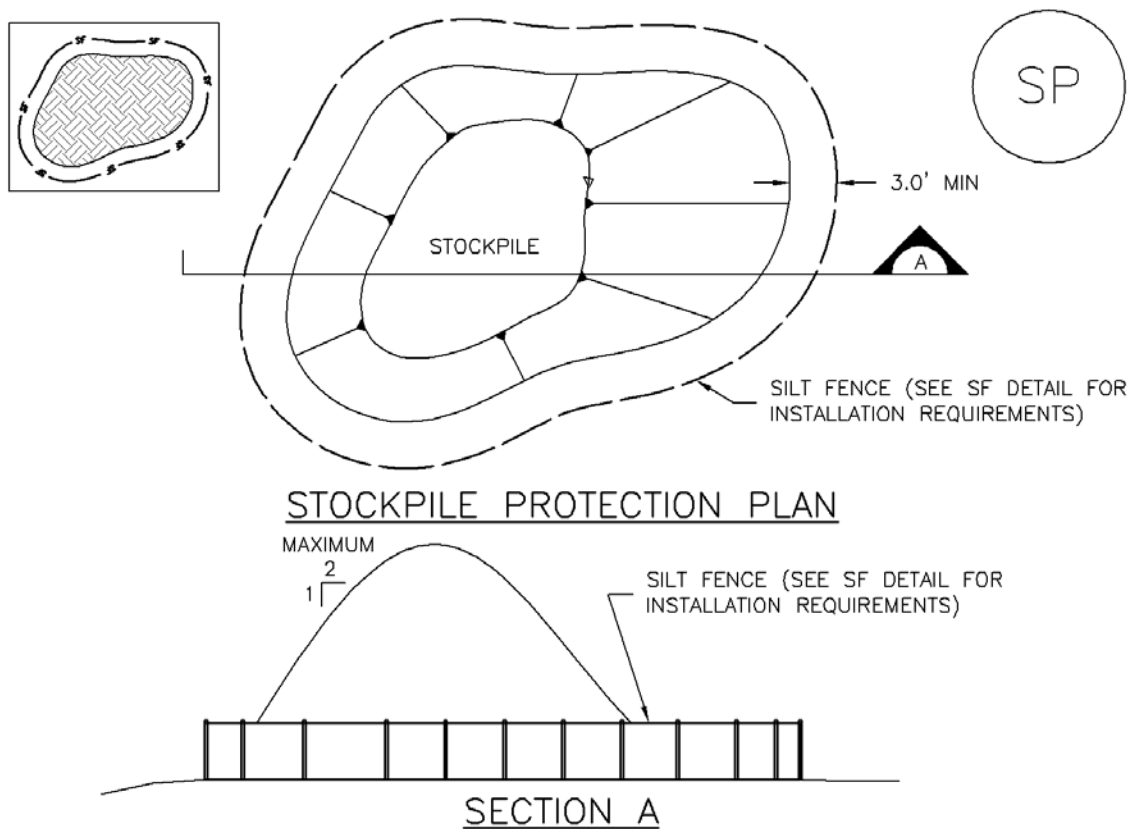
Maintenance and Removal

Inspect perimeter controls and inlet protection in accordance with their respective BMP Fact Sheets. Where seeding, mulch and/or soil binders are used, reseeding or reapplication of soil binder may be necessary.

When temporary removal of a perimeter BMP is necessary to access a stockpile, ensure BMPs are reinstalled in accordance with their respective design detail section.

Stockpile Management	
Functions	
Erosion Control	Yes
Sediment Control	Yes
Site/Material Management	Yes

When the stockpile is no longer needed, properly dispose of excess materials and revegetate or otherwise stabilize the ground surface where the stockpile was located.



SP-1. STOCKPILE PROTECTION

STOCKPILE PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATION OF STOCKPILES.
 - TYPE OF STOCKPILE PROTECTION.
2. INSTALL PERIMETER CONTROLS IN ACCORDANCE WITH THEIR RESPECTIVE DESIGN DETAILS. SILT FENCE IS SHOWN IN THE STOCKPILE PROTECTION DETAILS; HOWEVER, OTHER TYPES OF PERIMETER CONTROLS INCLUDING SEDIMENT CONTROL LOGS OR ROCK SOCKS MAY BE SUITABLE IN SOME CIRCUMSTANCES. CONSIDERATIONS FOR DETERMINING THE APPROPRIATE TYPE OF PERIMETER CONTROL FOR A STOCKPILE INCLUDE WHETHER THE STOCKPILE IS LOCATED ON A PERVIOUS OR IMPERVIOUS SURFACE, THE RELATIVE HEIGHTS OF THE PERIMETER CONTROL AND STOCKPILE, THE ABILITY OF THE PERIMETER CONTROL TO CONTAIN THE STOCKPILE WITHOUT FAILING IN THE EVENT THAT MATERIAL FROM THE STOCKPILE SHIFTS OR SLUMPS AGAINST THE PERIMETER, AND OTHER FACTORS.
3. STABILIZE THE STOCKPILE SURFACE WITH SURFACE ROUGHENING, TEMPORARY SEEDING AND MULCHING, EROSION CONTROL BLANKETS, OR SOIL BINDERS. SOILS STOCKPILED FOR AN EXTENDED PERIOD (TYPICALLY FOR MORE THAN 60 DAYS) SHOULD BE SEEDDED AND MULCHED WITH A TEMPORARY GRASS COVER ONCE THE STOCKPILE IS PLACED (TYPICALLY WITHIN 14 DAYS). USE OF MULCH ONLY OR A SOIL BINDER IS ACCEPTABLE IF THE STOCKPILE WILL BE IN PLACE FOR A MORE LIMITED TIME PERIOD (TYPICALLY 30-60 DAYS).
4. FOR TEMPORARY STOCKPILES ON THE INTERIOR PORTION OF A CONSTRUCTION SITE, WHERE OTHER DOWNGRADIENT CONTROLS, INCLUDING PERIMETER CONTROL, ARE IN PLACE, STOCKPILE PERIMETER CONTROLS MAY NOT BE REQUIRED.

STOCKPILE PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

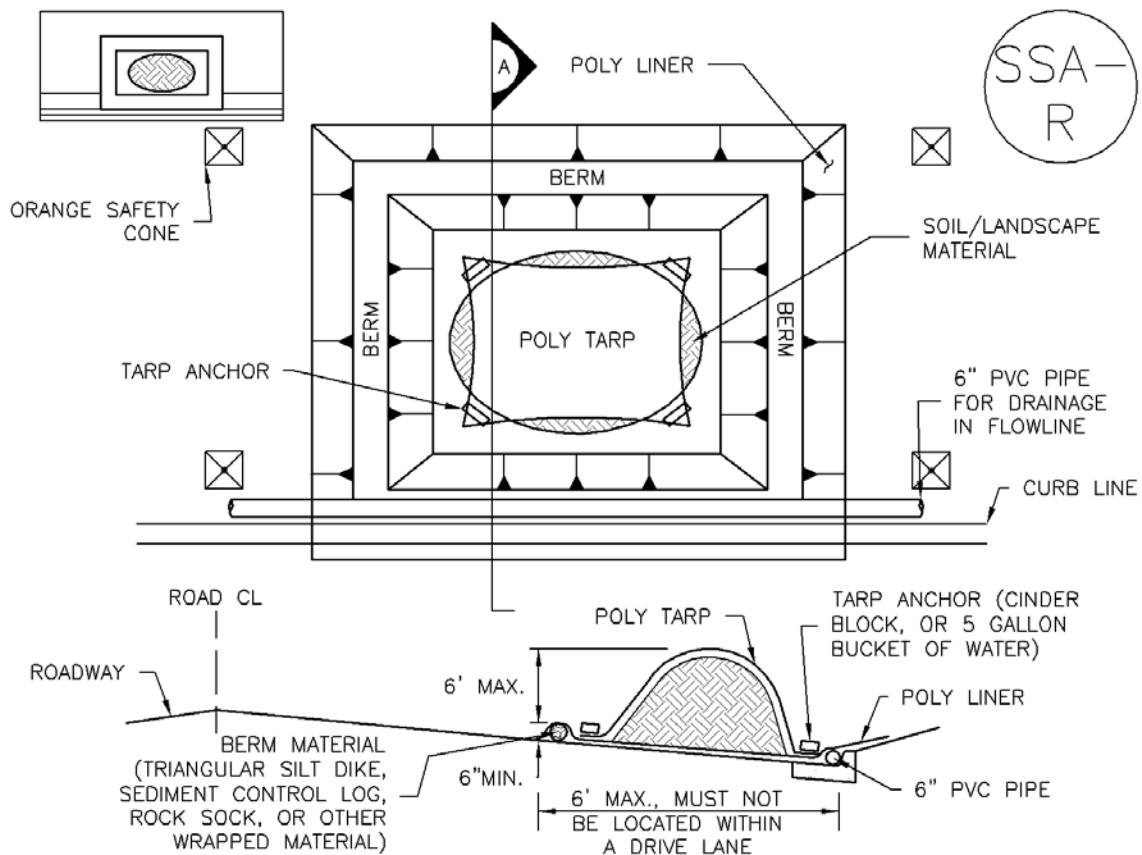
STOCKPILE PROTECTION MAINTENANCE NOTES

4. IF PERIMETER PROTECTION MUST BE MOVED TO ACCESS SOIL STOCKPILE, REPLACE PERIMETER CONTROLS BY THE END OF THE WORKDAY.

5. STOCKPILE PERIMETER CONTROLS CAN BE REMOVED ONCE ALL THE MATERIAL FROM THE STOCKPILE HAS BEEN USED.

(DETAILS ADAPTED FROM PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



SP-2. MATERIALS STAGING IN ROADWAY

MATERIALS STAGING IN ROADWAYS INSTALLATION NOTES

1. SEE PLAN VIEW FOR
 - LOCATION OF MATERIAL STAGING AREA(S).
 - CONTRACTOR MAY ADJUST LOCATION AND SIZE OF STAGING AREA WITH APPROVAL FROM THE LOCAL JURISDICTION.
2. FEATURE MUST BE INSTALLED PRIOR TO EXCAVATION, EARTHWORK OR DELIVERY OF MATERIALS.
3. MATERIALS MUST BE STATIONED ON THE POLY LINER. ANY INCIDENTAL MATERIALS DEPOSITED ON PAVED SECTION OR ALONG CURB LINE MUST BE CLEANED UP PROMPTLY.
4. POLY LINER AND TARP COVER SHOULD BE OF SIGNIFICANT THICKNESS TO PREVENT DAMAGE OR LOSS OF INTEGRITY.
5. SAND BAGS MAY BE SUBSTITUTED TO ANCHOR THE COVER TARP OR PROVIDE BERMING UNDER THE BASE LINER.
6. FEATURE IS NOT INTENDED FOR USE WITH WET MATERIAL THAT WILL BE DRAINING AND/OR SPREADING OUT ON THE POLY LINER OR FOR DEMOLITION MATERIALS.
7. THIS FEATURE CAN BE USED FOR:
 - UTILITY REPAIRS.
 - WHEN OTHER STAGING LOCATIONS AND OPTIONS ARE LIMITED.
 - OTHER LIMITED APPLICATION AND SHORT DURATION STAGING.

MATERIALS STAGING IN ROADWAY MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. INSPECT PVC PIPE ALONG CURB LINE FOR CLOGGING AND DEBRIS. REMOVE OBSTRUCTIONS PROMPTLY.

5. CLEAN MATERIAL FROM PAVED SURFACES BY SWEEPING OR VACUUMING.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM AURORA, COLORADO)

Description

Implement construction site good housekeeping practices to prevent pollution associated with solid, liquid and hazardous construction-related materials and wastes. Stormwater Management Plans (SWMPs) should clearly specify BMPs including these good housekeeping practices:

- Provide for waste management.
- Establish proper building material staging areas.
- Designate paint and concrete washout areas.
- Establish proper equipment/vehicle fueling and maintenance practices.
- Control equipment/vehicle washing and allowable non-stormwater discharges.
- Develop a spill prevention and response plan.

Acknowledgement: This Fact Sheet is based directly on EPA guidance provided in *Developing Your Stormwater Pollution Prevention Plan* (EPA 2007).

Appropriate Uses

Good housekeeping practices are necessary at all construction sites.

Design and Installation

The following principles and actions should be addressed in SWMPs:

- **Provide for Waste Management.** Implement management procedures and practices to prevent or reduce the exposure and transport of pollutants in stormwater from solid, liquid and sanitary wastes that will be generated at the site. Practices such as trash disposal, recycling, proper material handling, and cleanup measures can reduce the potential for stormwater runoff to pick up construction site wastes and discharge them to surface waters. Implement a comprehensive set of waste-management practices for hazardous or toxic materials, such as paints, solvents, petroleum products, pesticides, wood preservatives, acids, roofing tar, and other materials. Practices should include storage, handling, inventory, and cleanup procedures, in case of spills. Specific practices that should be considered include:

Solid or Construction Waste

- Designate trash and bulk waste-collection areas on-site.



Photographs GH-1 and GH-2. Proper materials storage and secondary containment for fuel tanks are important good housekeeping practices. Photos courtesy of CDOT and City of Aurora.

Good Housekeeping	
Functions	
Erosion Control	No
Sediment Control	No
Site/Material Management	Yes

- Recycle materials whenever possible (e.g., paper, wood, concrete, oil).
- Segregate and provide proper disposal options for hazardous material wastes.
- Clean up litter and debris from the construction site daily.
- Locate waste-collection areas away from streets, gutters, watercourses, and storm drains. Waste-collection areas (dumpsters, and such) are often best located near construction site entrances to minimize traffic on disturbed soils. Consider secondary containment around waste collection areas to minimize the likelihood of contaminated discharges.
- Empty waste containers before they are full and overflowing.

Sanitary and Septic Waste

- Provide convenient, well-maintained, and properly located toilet facilities on-site.
- Locate toilet facilities away from storm drain inlets and waterways to prevent accidental spills and contamination of stormwater.
- Maintain clean restroom facilities and empty portable toilets regularly.
- Where possible, provide secondary containment pans under portable toilets.
- Provide tie-downs or stake-downs for portable toilets.
- Educate employees, subcontractors, and suppliers on locations of facilities.
- Treat or dispose of sanitary and septic waste in accordance with state or local regulations. Do not discharge or bury wastewater at the construction site.
- Inspect facilities for leaks. If found, repair or replace immediately.
- Special care is necessary during maintenance (pump out) to ensure that waste and/or biocide are not spilled on the ground.

Hazardous Materials and Wastes

- Develop and implement employee and subcontractor education, as needed, on hazardous and toxic waste handling, storage, disposal, and cleanup.
- Designate hazardous waste-collection areas on-site.
- Place all hazardous and toxic material wastes in secondary containment.



Photograph GH-3. Locate portable toilet facilities on level surfaces away from waterways and storm drains. Photo courtesy of WWE.

- Hazardous waste containers should be inspected to ensure that all containers are labeled properly and that no leaks are present.
- **Establish Proper Building Material Handling and Staging Areas.** The SWMP should include comprehensive handling and management procedures for building materials, especially those that are hazardous or toxic. Paints, solvents, pesticides, fuels and oils, other hazardous materials or building materials that have the potential to contaminate stormwater should be stored indoors or under cover whenever possible or in areas with secondary containment. Secondary containment measures prevent a spill from spreading across the site and may include dikes, berms, curbing, or other containment methods. Secondary containment techniques should also ensure the protection of groundwater. Designate staging areas for activities such as fueling vehicles, mixing paints, plaster, mortar, and other potential pollutants. Designated staging areas enable easier monitoring of the use of materials and clean up of spills. Training employees and subcontractors is essential to the success of this pollution prevention principle. Consider the following specific materials handling and staging practices:
 - Train employees and subcontractors in proper handling and storage practices.
 - Clearly designate site areas for staging and storage with signs and on construction drawings. Staging areas should be located in areas central to the construction site. Segment the staging area into sub-areas designated for vehicles, equipment, or stockpiles. Construction entrances and exits should be clearly marked so that delivery vehicles enter/exit through stabilized areas with vehicle tracking controls (See Vehicle Tracking Control Fact Sheet).
 - Provide storage in accordance with Spill Protection, Control and Countermeasures (SPCC) requirements and plans and provide cover and impermeable perimeter control, as necessary, for hazardous materials and contaminated soils that must be stored on site.
 - Ensure that storage containers are regularly inspected for leaks, corrosion, support or foundation failure, or other signs of deterioration and tested for soundness.
 - Reuse and recycle construction materials when possible.
- **Designate Concrete Washout Areas.** Concrete contractors should be encouraged to use the washout facilities at their own plants or dispatch facilities when feasible; however, concrete washout commonly occurs on construction sites. If it is necessary to provide for concrete washout areas on-site, designate specific washout areas and design facilities to handle anticipated washout water. Washout areas should also be provided for paint and stucco operations. Because washout areas can be a source of pollutants from leaks or spills, care must be taken with regard to their placement and proper use. See the Concrete Washout Area Fact Sheet for detailed guidance.

Both self-constructed and prefabricated washout containers can fill up quickly when concrete, paint, and stucco work are occurring on large portions of the site. Be sure to check for evidence that contractors are using the washout areas and not dumping materials onto the ground or into drainage facilities. If the washout areas are not being used regularly, consider posting additional signage, relocating the facilities to more convenient locations, or providing training to workers and contractors.

When concrete, paint, or stucco is part of the construction process, consider these practices which will help prevent contamination of stormwater. Include the locations of these areas and the maintenance and inspection procedures in the SWMP.

- Do not washout concrete trucks or equipment into storm drains, streets, gutters, uncontained areas, or streams. Only use designated washout areas.
- Establish washout areas and advertise their locations with signs. Ensure that signage remains in good repair.
- Provide adequate containment for the amount of wash water that will be used.
- Inspect washout structures daily to detect leaks or tears and to identify when materials need to be removed.
- Dispose of materials properly. The preferred method is to allow the water to evaporate and to recycle the hardened concrete. Full service companies may provide dewatering services and should dispose of wastewater properly. Concrete wash water can be highly polluted. It should not be discharged to any surface water, storm sewer system, or allowed to infiltrate into the ground in the vicinity of waterbodies. Washwater should not be discharged to a sanitary sewer system without first receiving written permission from the system operator.
- **Establish Proper Equipment/Vehicle Fueling and Maintenance Practices.** Create a clearly designated on-site fueling and maintenance area that is clean and dry. The on-site fueling area should have a spill kit, and staff should know how to use it. If possible, conduct vehicle fueling and maintenance activities in a covered area. Consider the following practices to help prevent the discharge of pollutants to stormwater from equipment/vehicle fueling and maintenance. Include the locations of designated fueling and maintenance areas and inspection and maintenance procedures in the SWMP.
 - Train employees and subcontractors in proper fueling procedures (stay with vehicles during fueling, proper use of pumps, emergency shutoff valves, etc.).
 - Inspect on-site vehicles and equipment regularly for leaks, equipment damage, and other service problems.
 - Clearly designate vehicle/equipment service areas away from drainage facilities and watercourses to prevent stormwater run-on and runoff.
 - Use drip pans, drip cloths, or absorbent pads when replacing spent fluids.
 - Collect all spent fluids, store in appropriate labeled containers in the proper storage areas, and recycle fluids whenever possible.
- **Control Equipment/Vehicle Washing and Allowable Non-Stormwater Discharges.** Implement practices to prevent contamination of surface and groundwater from equipment and vehicle wash water. Representative practices include:
 - Educate employees and subcontractors on proper washing procedures.
 - Use off-site washing facilities, when available.
 - Clearly mark the washing areas and inform workers that all washing must occur in this area.
 - Contain wash water and treat it using BMPs. Infiltrate washwater when possible, but maintain separation from drainage paths and waterbodies.

- Use high-pressure water spray at vehicle washing facilities without detergents. Water alone can remove most dirt adequately.
- Do not conduct other activities, such as vehicle repairs, in the wash area.
- Include the location of the washing facilities and the inspection and maintenance procedures in the SWMP.
- **Develop a Spill Prevention and Response Plan.** Spill prevention and response procedures must be identified in the SWMP. Representative procedures include identifying ways to reduce the chance of spills, stop the source of spills, contain and clean up spills, dispose of materials contaminated by spills, and train personnel responsible for spill prevention and response. The plan should also specify material handling procedures and storage requirements and ensure that clear and concise spill cleanup procedures are provided and posted for areas in which spills may potentially occur. When developing a spill prevention plan, include the following:
 - Note the locations of chemical storage areas, storm drains, tributary drainage areas, surface waterbodies on or near the site, and measures to stop spills from leaving the site.
 - Provide proper handling and safety procedures for each type of waste. Keep Material Safety Data Sheets (MSDSs) for chemical used on site with the SWMP.
 - Establish an education program for employees and subcontractors on the potential hazards to humans and the environment from spills and leaks.
 - Specify how to notify appropriate authorities, such as police and fire departments, hospitals, or municipal sewage treatment facilities to request assistance. Emergency procedures and contact numbers should be provided in the SWMP and posted at storage locations.
 - Describe the procedures, equipment and materials for immediate cleanup of spills and proper disposal.
 - Identify personnel responsible for implementing the plan in the event of a spill. Update the spill prevention plan and clean up materials as changes occur to the types of chemicals stored and used at the facility.

Spill Prevention, Control, and Countermeasure (SPCC) Plan

Construction sites may be subject to 40 CFR Part 112 regulations that require the preparation and implementation of a SPCC Plan to prevent oil spills from aboveground and underground storage tanks. The facility is subject to this rule if it is a non-transportation-related facility that:

- Has a total storage capacity greater than 1,320 gallons or a completely buried storage capacity greater than 42,000 gallons.
- Could reasonably be expected to discharge oil in quantities that may be harmful to navigable waters of the United States and adjoining shorelines.

Furthermore, if the facility is subject to 40 CFR Part 112, the SWMP should reference the SPCC Plan. To find out more about SPCC Plans, see EPA's website on SPCC at www.epa.gov/oilspill/spcc.htm.

Reporting Oil Spills

In the event of an oil spill, contact the National Response Center toll free at 1-800-424- 8802 for assistance, or for more details, visit their website: www.nrc.uscg.mil.

Maintenance and Removal

Effective implementation of good housekeeping practices is dependent on clear designation of personnel responsible for supervising and implementing good housekeeping programs, such as site cleanup and disposal of trash and debris, hazardous material management and disposal, vehicle and equipment maintenance, and other practices. Emergency response "drills" may aid in emergency preparedness.

Checklists may be helpful in good housekeeping efforts.

Staging and storage areas require permanent stabilization when the areas are no longer being used for construction-related activities.

Construction-related materials, debris and waste must be removed from the construction site once construction is complete.

Design Details

See the following Fact Sheets for related Design Details:

MM-1 Concrete Washout Area

MM-2 Stockpile Management

SM-4 Vehicle Tracking Control

Design details are not necessary for other good housekeeping practices; however, be sure to designate where specific practices will occur on the appropriate construction drawings.

Description

A silt fence is a woven geotextile fabric attached to wooden posts and trenched into the ground. It is designed as a sediment barrier to intercept sheet flow runoff from disturbed areas.

Appropriate Uses

A silt fence can be used where runoff is conveyed from a disturbed area as sheet flow. Silt fence is not designed to receive concentrated flow or to be used as a filter fabric. Typical uses include:

- Down slope of a disturbed area to accept sheet flow.
- Along the perimeter of a receiving water such as a stream, pond or wetland.
- At the perimeter of a construction site.



Photograph SF-1. Silt fence creates a sediment barrier, forcing sheet flow runoff to evaporate or infiltrate.

Design and Installation

Silt fence should be installed along the contour of slopes so that it intercepts sheet flow. The maximum recommended tributary drainage area per 100 lineal feet of silt fence, installed along the contour, is approximately 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. Longer and steeper slopes require additional measures. This recommendation only applies to silt fence installed along the contour. Silt fence installed for other uses, such as perimeter control, should be installed in a way that will not produce concentrated flows. For example, a "J-hook" installation may be appropriate to force runoff to pond and evaporate or infiltrate in multiple areas rather than concentrate and cause erosive conditions parallel to the silt fence.

See Detail SF-1 for proper silt fence installation, which involves proper trenching, staking, securing the fabric to the stakes, and backfilling the silt fence. Properly installed silt fence should not be easily pulled out by hand and there should be no gaps between the ground and the fabric.

Silt fence must meet the minimum allowable strength requirements, depth of installation requirement, and other specifications in the design details. Improper installation of silt fence is a common reason for silt fence failure; however, when properly installed and used for the appropriate purposes, it can be highly effective.

Silt Fence	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

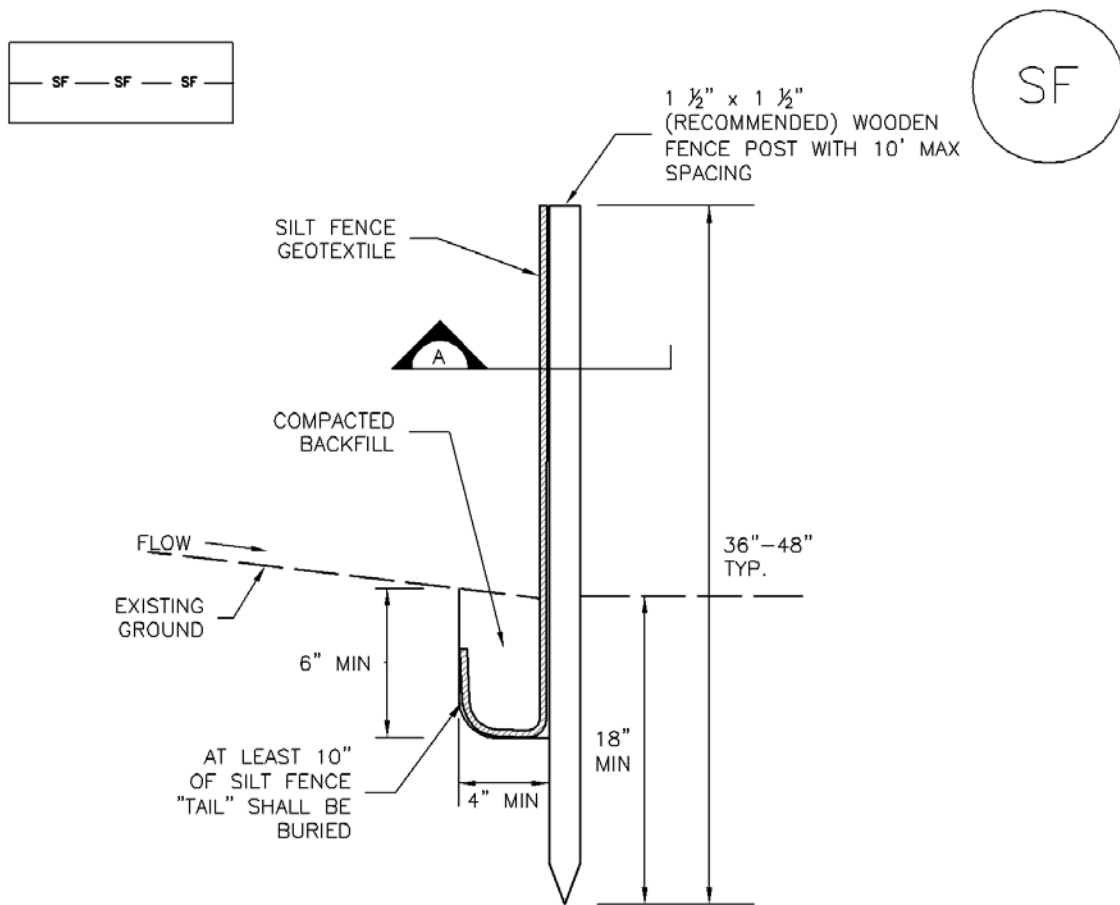
Maintenance and Removal

Inspection of silt fence includes observing the material for tears or holes and checking for slumping fence and undercut areas bypassing flows. Repair of silt fence typically involves replacing the damaged section with a new section. Sediment accumulated behind silt fence should be removed, as needed to maintain BMP effectiveness, typically before it reaches a depth of 6 inches.

Silt fence may be removed when the upstream area has reached final stabilization.



Photograph SF-2. When silt fence is not installed along the contour, a "J-hook" installation may be appropriate to ensure that the BMP does not create concentrated flow parallel to the silt fence. Photo courtesy of Tom Gore.



SILT FENCE



POSTS SHALL OVERLAP AT JOINTS SO THAT NO GAPS EXIST IN SILT FENCE



SECTION A

SF-1. SILT FENCE

SILT FENCE INSTALLATION NOTES

1. SILT FENCE MUST BE PLACED AWAY FROM THE TOE OF THE SLOPE TO ALLOW FOR WATER PONDING. SILT FENCE AT THE TOE OF A SLOPE SHOULD BE INSTALLED IN A FLAT LOCATION AT LEAST SEVERAL FEET (2–5 FT) FROM THE TOE OF THE SLOPE TO ALLOW ROOM FOR PONDING AND DEPOSITION.
2. A UNIFORM 6" X 4" ANCHOR TRENCH SHALL BE EXCAVATED USING TRENCHER OR SILT FENCE INSTALLATION DEVICE. NO ROAD GRADERS, BACKHOES, OR SIMILAR EQUIPMENT SHALL BE USED.
3. COMPACT ANCHOR TRENCH BY HAND WITH A "JUMPING JACK" OR BY WHEEL ROLLING. COMPACTION SHALL BE SUCH THAT SILT FENCE RESISTS BEING PULLED OUT OF ANCHOR TRENCH BY HAND.
4. SILT FENCE SHALL BE PULLED TIGHT AS IT IS ANCHORED TO THE STAKES. THERE SHOULD BE NO NOTICEABLE SAG BETWEEN STAKES AFTER IT HAS BEEN ANCHORED TO THE STAKES.
5. SILT FENCE FABRIC SHALL BE ANCHORED TO THE STAKES USING 1" HEAVY DUTY STAPLES OR NAILS WITH 1" HEADS. STAPLES AND NAILS SHOULD BE PLACED 3" ALONG THE FABRIC DOWN THE STAKE.
6. AT THE END OF A RUN OF SILT FENCE ALONG A CONTOUR, THE SILT FENCE SHOULD BE TURNED PERPENDICULAR TO THE CONTOUR TO CREATE A "J-HOOK." THE "J-HOOK" EXTENDING PERPENDICULAR TO THE CONTOUR SHOULD BE OF SUFFICIENT LENGTH TO KEEP RUNOFF FROM FLOWING AROUND THE END OF THE SILT FENCE (TYPICALLY 10' – 20').
7. SILT FENCE SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

SILT FENCE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SEDIMENT ACCUMULATED UPSTREAM OF THE SILT FENCE SHALL BE REMOVED AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY 6".
5. REPAIR OR REPLACE SILT FENCE WHEN THERE ARE SIGNS OF WEAR, SUCH AS SAGGING, TEARING, OR COLLAPSE.
6. SILT FENCE IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION, OR IS REPLACED BY AN EQUIVALENT PERIMETER SEDIMENT CONTROL BMP.
7. WHEN SILT FENCE IS REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

A sediment control log is a linear roll made of natural materials such as straw, coconut fiber, or other fibrous material trenched into the ground and held with a wooden stake. Sediment control logs are also often referred to as "straw wattles." They are used as a sediment barrier to intercept sheet flow runoff from disturbed areas.



Appropriate Uses

Sediment control logs can be used in the following applications to trap sediment:

- As perimeter control for stockpiles and the site.
- As part of inlet protection designs.
- As check dams in small drainage ditches. (Sediment control logs are not intended for use in channels with high flow velocities.)
- On disturbed slopes to shorten flow lengths (as an erosion control).
- As part of multi-layered perimeter control along a receiving water such as a stream, pond or wetland.



Photographs SCL-1 and SCL-2. Sediment control logs used as 1) a perimeter control around a soil stockpile; and, 2) as a "J-hook" perimeter control at the corner of a construction site.

Sediment control logs work well in combination with other layers of erosion and sediment controls.

Design and Installation

Sediment control logs should be installed along the contour to avoid concentrating flows. The maximum allowable tributary drainage area per 100 lineal feet of sediment control log, installed along the contour, is approximately 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. Longer and steeper slopes require additional measures. This recommendation only applies to sediment control logs installed along the contour. When installed for other uses, such as perimeter control, it should be installed in a way that will not produce concentrated flows. For example, a "J-hook" installation may be appropriate to force runoff to pond and evaporate or infiltrate in multiple areas rather than concentrate and cause erosive conditions parallel to the BMP.

Sediment Control Log	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	No

Although sediment control logs initially allow runoff to flow through the BMP, they can quickly become a barrier and should be installed is if they are impermeable.

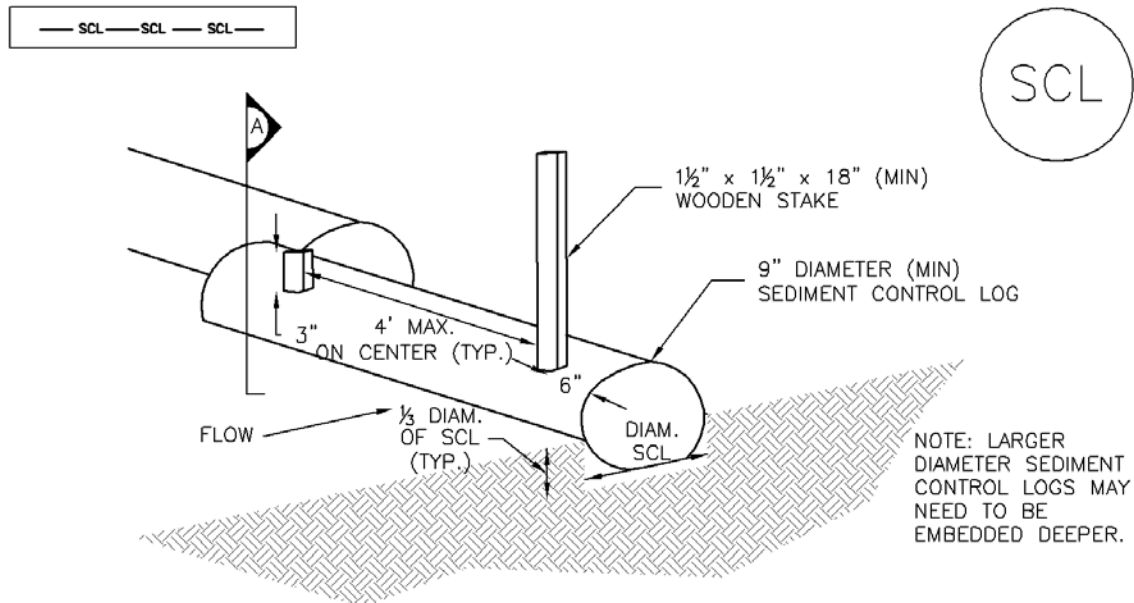
Design details and notes for sediment control logs are provided in Detail SCL-1. Sediment logs must be properly trenched and staked into the ground to prevent undercutting, bypassing and displacement. When installed on slopes, sediment control logs should be installed along the contours (i.e., perpendicular to flow).

Improper installation can lead to poor performance. Be sure that sediment control logs are properly trenched, anchored and tightly jointed.

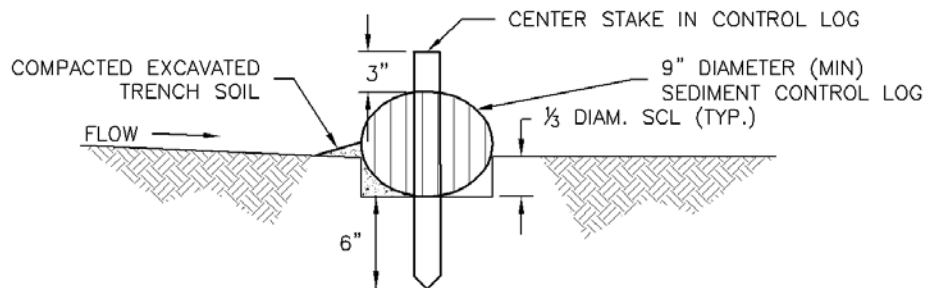
Maintenance and Removal

Be aware that sediment control logs will eventually degrade. Remove accumulated sediment before the depth is one-half the height of the sediment log and repair damage to the sediment log, typically by replacing the damaged section.

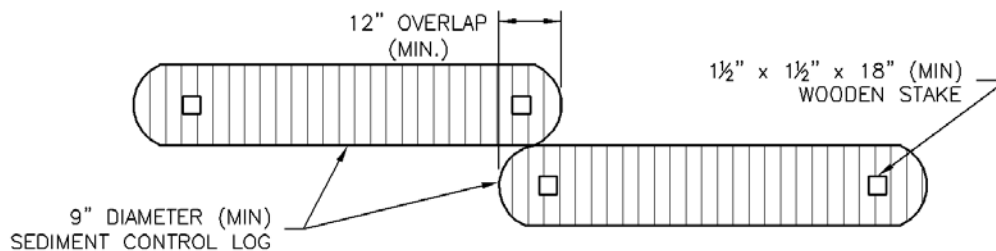
Once the upstream area is stabilized, remove and properly dispose of the logs. Areas disturbed beneath the logs may need to be seeded and mulched. Sediment control logs that are biodegradable may occasionally be left in place (e.g., when logs are used in conjunction with erosion control blankets as permanent slope breaks). However, removal of sediment control logs after final stabilization is typically recommended when used in perimeter control, inlet protection and check dam applications.



SEDIMENT CONTROL LOG

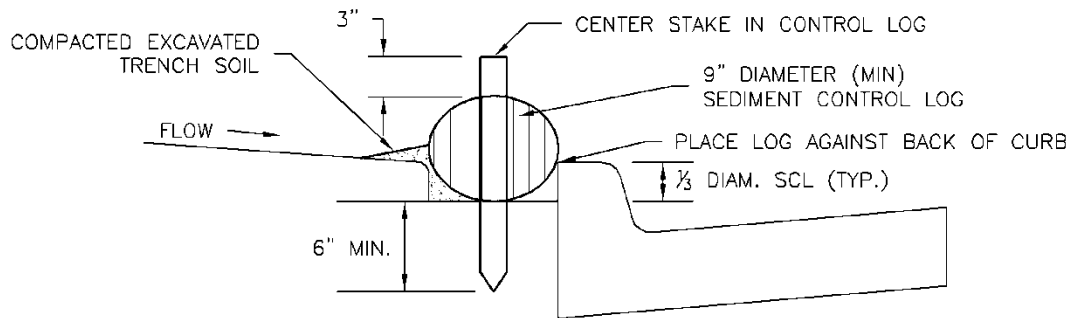


SECTION A

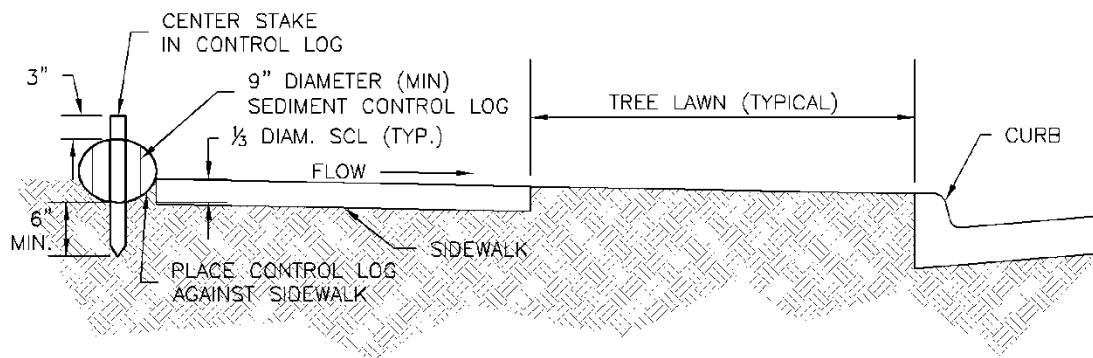


SEDIMENT CONTROL LOG JOINTS

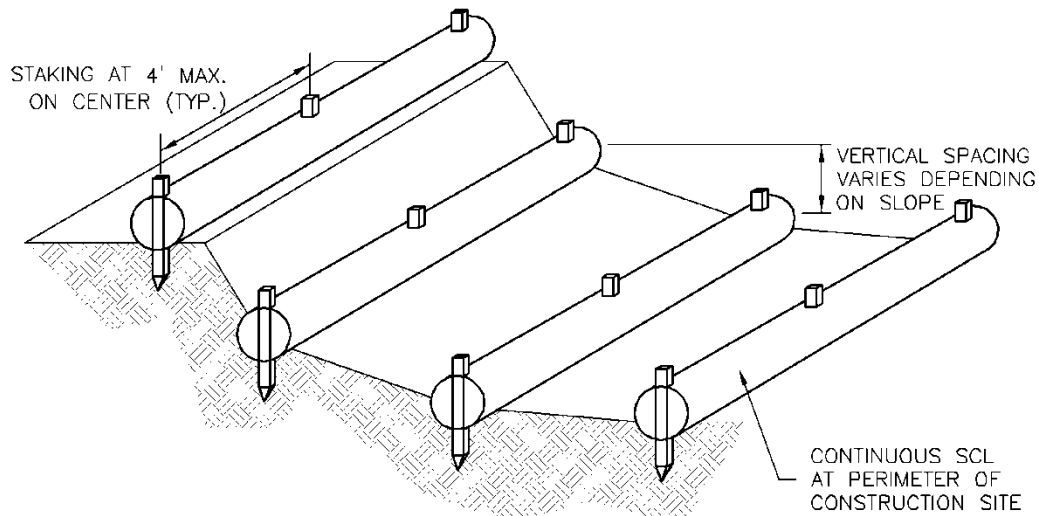
SCL-1. SEDIMENT CONTROL LOG



SCL-2. SEDIMENT CONTROL LOG AT BACK OF CURB



SCL-3. SEDIMENT CONTROL LOG AT SIDEWALK WITH
TREE LAWN



SCL-4. SEDIMENT CONTROL LOGS TO CONTROL
SLOPE LENGTH

SEDIMENT CONTROL LOG INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION AND LENGTH OF SEDIMENT CONTROL LOGS.
2. SEDIMENT CONTROL LOGS THAT ACT AS A PERIMETER CONTROL SHALL BE INSTALLED PRIOR TO ANY UPGRADE LAND-DISTURBING ACTIVITIES.
3. SEDIMENT CONTROL LOGS SHALL CONSIST OF STRAW, COMPOST, EXCELSIOR OR COCONUT FIBER, AND SHALL BE FREE OF ANY NOXIOUS WEED SEEDS OR DEFECTS INCLUDING RIPS, HOLES AND OBVIOUS WEAR.
4. SEDIMENT CONTROL LOGS MAY BE USED AS SMALL CHECK DAMS IN DITCHES AND SWALES. HOWEVER, THEY SHOULD NOT BE USED IN PERENNIAL STREAMS OR HIGH VELOCITY DRAINAGE WAYS.
5. IT IS RECOMMENDED THAT SEDIMENT CONTROL LOGS BE TRENCHED INTO THE GROUND TO A DEPTH OF APPROXIMATELY $\frac{1}{2}$ OF THE DIAMETER OF THE LOG. IF TRENCHING TO THIS DEPTH IS NOT FEASIBLE AND/OR DESIRABLE (SHORT TERM INSTALLATION WITH DESIRE NOT TO DAMAGE LANDSCAPE) A LESSER TRENCHING DEPTH MAY BE ACCEPTABLE WITH MORE ROBUST STAKING
6. THE UPHILL SIDE OF THE SEDIMENT CONTROL LOG SHALL BE BACKFILLED WITH SOIL THAT IS FREE OF ROCKS AND DEBRIS. THE SOIL SHALL BE TIGHTLY COMPACTED INTO THE SHAPE OF A RIGHT TRIANGLE USING A SHOVEL OR WEIGHTED LAWN ROLLER.
7. FOLLOW MANUFACTURERS' GUIDANCE FOR STAKING. IF MANUFACTURERS' INSTRUCTIONS DO NOT SPECIFY SPACING, STAKES SHALL BE PLACED ON 4' CENTERS AND EMBEDDED A MINIMUM OF 6" INTO THE GROUND. 3" OF THE STAKE SHALL PROTRUDE FROM THE TOP OF THE LOG. STAKES THAT ARE BROKEN PRIOR TO INSTALLATION SHALL BE REPLACED.

SEDIMENT CONTROL LOG MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SEDIMENT ACCUMULATED UPSTREAM OF SEDIMENT CONTROL LOG SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY $\frac{1}{2}$ OF THE HEIGHT OF THE SEDIMENT CONTROL LOG.
5. SEDIMENT CONTROL LOG SHALL BE REMOVED AT THE END OF CONSTRUCTION. IF DISTURBED AREAS EXIST AFTER REMOVAL, THEY SHALL BE COVERED WITH TOP SOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, JEFFERSON COUNTY, COLORADO, DOUGLAS COUNTY, COLORADO, AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

A straw bale barrier is a linear wall of straw bales designed to intercept sheet flow and trap sediment before runoff exits a disturbed area.

Appropriate Uses

Appropriate uses of properly installed straw bale barriers may include:

- As a perimeter control for a site or soil stockpile.
- As a sediment control at the toe of an erodible slope.
- Along the edge of a stream or drainage pathway to reduce sediment laden runoff from entering the waterway.
- As part of an inlet protection design in sump conditions (See Inlet Protection BMP).



Photograph SBB-1. Straw bale barrier used for perimeter control. Photo courtesy of Tom Gore.

Do not use straw bale barriers in areas of concentrated flow or in areas where ponding is not desirable. Straw bales tend to degrade quickly, so they should generally not be used in areas where longer term disturbance is expected.

Due to a history of inappropriate placement, poor installation, and short effective lifespan, the use of straw bales is discouraged or prohibited by some communities.

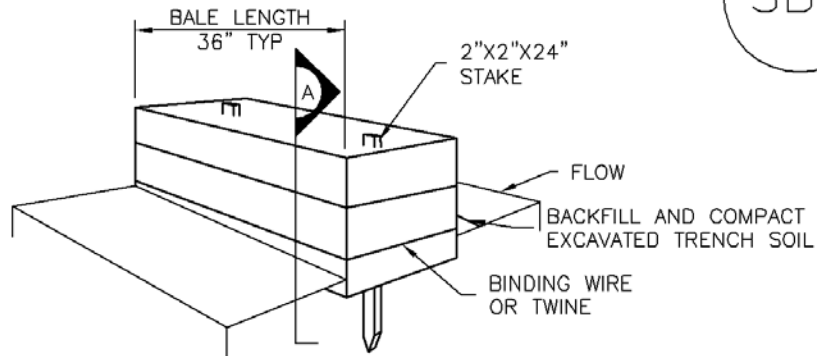
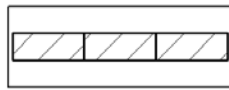
Design and Installation

The maximum recommended tributary drainage area per 100 lineal feet of straw bale barrier is 0.25 acres with a disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1; longer and steeper slopes require additional measures. Design details with notes are provided in Detail SBB-1. To be effective, bales must be installed in accordance with the design details with proper trenching, staking, and binding. Jute and cotton string must not be used to bind the straw bale. The bales should be certified weed-free prior to use.

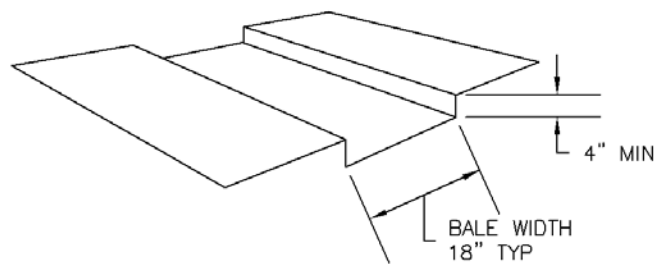
Maintenance and Removal

Check bales for rotting and replace as necessary. Straw bales degrade, and rotting bales require replacement on a regular basis (as often as every three months) depending on environmental conditions. Check for undercutting, bypassed flows, and displacement. Repair by properly re-installing the straw bale barrier and repairing washouts around the bales. Remove sediment accumulated behind the bale when it reaches one-quarter of the bale height. Remove and properly dispose of the straw bale once the upstream area has been stabilized. Areas of disturbance beneath the bale should be seeded and mulched when the bale is removed.

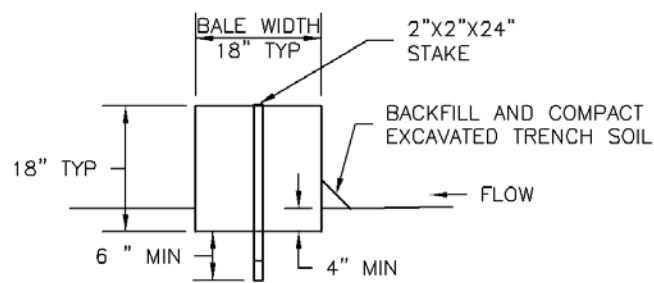
Straw Bale Barrier	
Functions	
Erosion Control	No
Sediment Control	Moderate
Site/Material Management	No



STRAW BALE



TRENCH FOR STRAW BALE



SECTION A

SBB-1. STRAW BALE

STRAW BALE INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
-LOCATION(S) OF STRAW BALES.
2. STRAW BALES SHALL CONSIST OF CERTIFIED WEED FREE STRAW OR HAY. LOCAL JURISDICTIONS MAY REQUIRE PROOF THAT BALES ARE WEED FREE.
3. STRAW BALES SHALL CONSIST OF APPROXIMATELY 5 CUBIC FEET OF STRAW OR HAY AND WEIGH NOT LESS THAN 35 POUNDS.
4. WHEN STRAW BALES ARE USED IN SERIES AS A BARRIER, THE END OF EACH BALE SHALL BE TIGHTLY ABUTTING ONE ANOTHER.
5. STRAW BALE DIMENSIONS SHALL BE APPROXIMATELY 36"x18"x18".
6. A UNIFORM ANCHOR TRENCH SHALL BE EXCAVATED TO A DEPTH OF 4". STRAW BALES SHALL BE PLACED SO THAT BINDING TWINE IS ENCOMPASSING THE VERTICAL SIDES OF THE BALE(S). ALL EXCAVATED SOIL SHALL BE PLACED ON THE UPHILL SIDE OF THE STRAW BALE(S) AND COMPACTED.
7. TWO (2) WOODEN STAKES SHALL BE USED TO HOLD EACH BALE IN PLACE. WOODEN STAKES SHALL BE 2"x2"x24". WOODEN STAKES SHALL BE DRIVEN 6" INTO THE GROUND.

STRAW BALE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. STRAW BALES SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED, ROTTEN, OR DAMAGED BEYOND REPAIR.
5. SEDIMENT ACCUMULATED UPSTREAM OF STRAW BALE BARRIER SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY $\frac{1}{4}$ OF THE HEIGHT OF THE STRAW BALE BARRIER.
6. STRAW BALES ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.
7. WHEN STRAW BALES ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

A brush barrier is a perimeter sediment control constructed with stacked shrubs, tree limbs, and bushy vegetation that has been cleared from a construction area. Brush barriers reduce sediment loads by intercepting and slowing sheet flow from disturbed areas.

Appropriate Uses

A brush barrier is an appropriate BMP at sites where there is adequate brush from the clearing and grubbing of the construction site to construct an effective brush barrier. Brush barriers are typically used at the toe of slopes and should be implemented in combination with other BMPs such as surface roughening and reseeding. Brush barriers should be considered short-term, supplemental BMPs because they are constructed of materials that naturally decompose. Brush barriers are not acceptable as a sole means of perimeter control, but they may be used internally within a site to reduce slope length or at the site perimeter in combination with other perimeter control BMPs for multi-layered protection.

Brush barriers are not appropriate for high-velocity flow areas. A large amount of material is needed to construct a useful brush barrier; therefore, alternative perimeter controls such as a fabric silt fence may be more appropriate for sites with little material from clearing.

Design and Installation

The drainage area for brush barriers should be no greater than 0.25 acre per 100 feet of barrier length. Additionally, the drainage slope leading down to a brush barrier must be no greater than 3:1 and no longer than 150 feet.

To construct an effective brush barrier, use only small shrubs and limbs with diameters of 6 inches or less. Larger materials (such as a tree stump) can create void spaces in the barrier, making it ineffective. The brush barrier mound should be at least 3 feet high and 5 feet wide at its base.

In order to avoid significant movement of the brush and improve effectiveness, a filter fabric can be placed over the top of the brush pile, keyed in on the upstream side, and anchored on the downstream side. On the upgradient side, the filter fabric cover should be buried in a trench 4 inches deep and 6 inches wide.



Photograph BB-1. Brush barrier constructed with chipped wood.
Photo courtesy of EPA.

Brush Barrier	
Functions	
Erosion Control	Moderate
Sediment Control	Moderate
Site/Material	No

Maintenance and Removal

Inspect the brush barrier for voids where concentrated flow or erosion is occurring. Voids in the brush barrier should be filled with additional brush. Accumulated sediment should be removed from the uphill side of the barrier when sediment height reaches one-third of the height of the barrier.

If filter fabric is used, inspect the filter fabric for damage; replace and properly secure it, as needed.

Once the upstream area has been vegetated or stabilized, the brush barrier should be removed and the underlying area revegetated.

Description

A rock sock is constructed of gravel that has been wrapped by wire mesh or a geotextile to form an elongated cylindrical filter. Rock socks are typically used either as a perimeter control or as part of inlet protection. When placed at angles in the curb line, rock socks are typically referred to as curb socks. Rock socks are intended to trap sediment from stormwater runoff that flows onto roadways as a result of construction activities.



Photograph RS-1. Rock socks placed at regular intervals in a curb line can help reduce sediment loading to storm sewer inlets. Rock socks can also be used as perimeter controls.

Appropriate Uses

Rock socks can be used at the perimeter of a disturbed area to control localized sediment loading. A benefit of rock socks as opposed to other perimeter controls is that they do not have to be trenched or staked into the ground; therefore, they are often used on roadway construction projects where paved surfaces are present.

Use rock socks in inlet protection applications when the construction of a roadway is substantially complete and the roadway has been directly connected to a receiving storm system.

Design and Installation

When rock socks are used as perimeter controls, the maximum recommended tributary drainage area per 100 lineal feet of rock socks is approximately 0.25 acres with disturbed slope length of up to 150 feet and a tributary slope gradient no steeper than 3:1. A rock sock design detail and notes are provided in Detail RS-1. Also see the Inlet Protection Fact Sheet for design and installation guidance when rock socks are used for inlet protection and in the curb line.

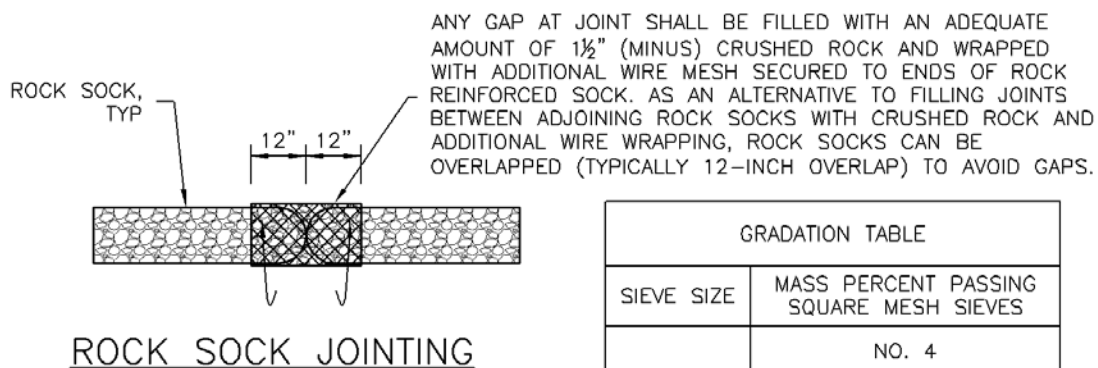
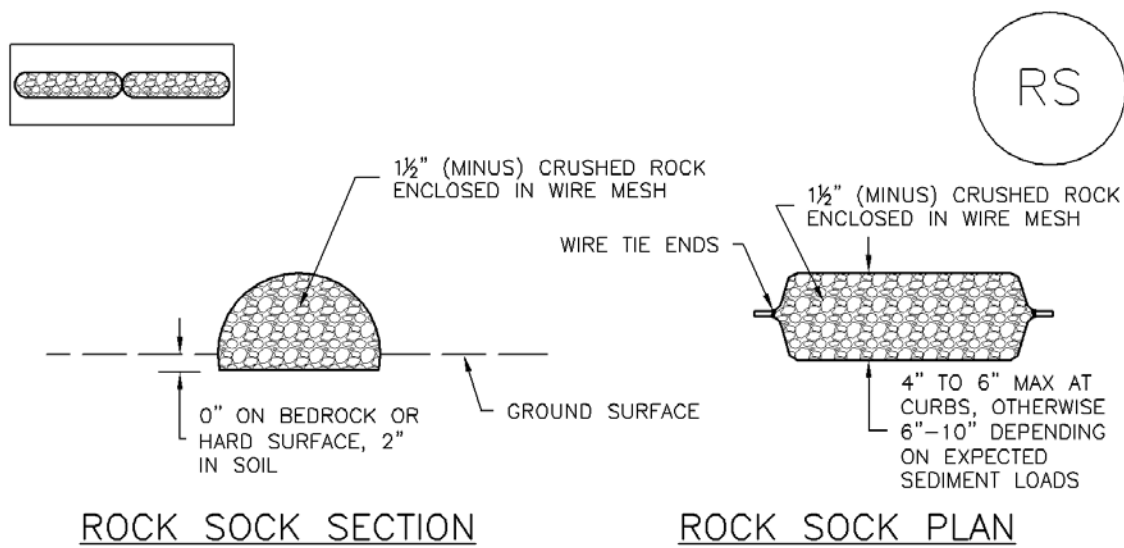
When placed in the gutter adjacent to a curb, rock socks should protrude no more than two feet from the curb in order for traffic to pass safely. If located in a high traffic area, place construction markers to alert drivers and street maintenance workers of their presence.

Maintenance and Removal

Rock socks are susceptible to displacement and breaking due to vehicle traffic. Inspect rock socks for damage and repair or replace as necessary. Remove sediment by sweeping or vacuuming as needed to maintain the functionality of the BMP, typically when sediment has accumulated behind the rock sock to one-half of the sock's height.

Once upstream stabilization is complete, rock socks and accumulated sediment should be removed and properly disposed.

Rock Sock	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No



ROCK SOCK INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
-LOCATION(S) OF ROCK SOCKS.
2. CRUSHED ROCK SHALL BE 1½" (MINUS) IN SIZE WITH A FRACTURED FACE (ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN ON THIS SHEET (1½" MINUS).
3. WIRE MESH SHALL BE FABRICATED OF 10 GAGE POULTRY MESH, OR EQUIVALENT, WITH A MAXIMUM OPENING OF ½", RECOMMENDED MINIMUM ROLL WIDTH OF 48"
4. WIRE MESH SHALL BE SECURED USING "HOG RINGS" OR WIRE TIES AT 6" CENTERS ALONG ALL JOINTS AND AT 2" CENTERS ON ENDS OF SOCKS.
5. SOME MUNICIPALITIES MAY ALLOW THE USE OF FILTER FABRIC AS AN ALTERNATIVE TO WIRE MESH FOR THE ROCK ENCLOSURE.

RS-1. ROCK SOCK PERIMETER CONTROL

ROCK SOCK MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. ROCK SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED, OR DAMAGED BEYOND REPAIR.
5. SEDIMENT ACCUMULATED UPSTREAM OF ROCK SOCKS SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY $\frac{1}{2}$ OF THE HEIGHT OF THE ROCK SOCK.
6. ROCK SOCKS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.
7. WHEN ROCK SOCKS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

NOTE: THE DETAILS INCLUDED WITH THIS FACT SHEET SHOW COMMONLY USED, CONVENTIONAL METHODS OF ROCK SOCK INSTALLATION IN THE DENVER METROPOLITAN AREA. THERE ARE MANY OTHER SIMILAR PROPRIETARY PRODUCTS ON THE MARKET. UDFCD NEITHER NDORSES NOR DISCOURAGES USE OF PROPRIETARY PROTECTION PRODUCTS; HOWEVER, IN THE EVENT PROPRIETARY METHODS ARE USED, THE APPROPRIATE DETAIL FROM THE MANUFACTURER MUST BE INCLUDED IN THE SWMP AND THE BMP MUST BE INSTALLED AND MAINTAINED AS SHOWN IN THE MANUFACTURER'S DETAILS.

Filter Berm (FB)

SC-6



Description

A filter berm is a temporary ridge made up of natural materials that already occur on the project site such. Brush filter berms use small tree branches, root mats, grass, leaves, stone, or other debris or material naturally available or left over from site clearing and grubbing (slash). Rock filter berms use site gravel, stone, or rock. Both types of filter berms are placed along a level contour to slow, filter, and divert flow and act as an efficient form of sediment control. In some configurations, filter berms are covered with a filter cloth to stabilize the structure and improve barrier efficiency.

Applicability

The drainage area for filter berms must be no greater than 2 acres. In addition, the drainage slope leading down to a filter berm must be no greater than 2:1 and no longer than 100 feet. The following are suitable applications:

- 5 to 7 feet beyond the toe of slopes.
- Along the site perimeter.
- Along streams and channels, or adjacent to roadways.
- Around temporary spoil areas or other small cleared areas.

Limitations

- Intended to be used only in gently sloping areas, and are not appropriate for high-velocity flow areas.
- Brush filter berms have limited usefulness because they are constructed of materials that decompose.

- A large amount of material is needed to construct a useful filter berm. Therefore, filter berms are only applicable to sites where there is enough brush material from clearing and grubbing or rock material to form a sufficiently sized berm.
- May be difficult to remove after construction.

Design Criteria

No formal design is required.

Construction Specifications

Brush (Slash) Filter Berms

See Figure FB-1 for installation details.

1. Place material cleared from the site across the slope or swale. Material with a diameter larger than six inches should not be used.
2. Cut up brush if necessary and compact to avoid large voids within the barrier.
3. The barrier mound should be at least three feet high and five feet wide at its base.
4. It is recommended, but not required, that the mound be covered with a filter fabric barrier to hold the material in place and increase sediment barrier efficiency. If using a filter fabric cover, bury the edge in a trench four inches deep and six inches wide on the drainage side of the barrier. This is done to secure the fabric and create a barrier to sediment while allowing storm water to pass through the water-permeable filter fabric. The fabric should be extended just over the peak of the brush mound and secured on the down-slope edge of the fabric by fastening it to twine or small-diameter rope that is staked securely.

Rock Filter Berms

See Figure FB-2 for installation details.

1. Place filter berm along a level contour. Use well-graded, angular site gravel or crushed rock of medium to large diameter with larger rocks on the bottom.
2. If desired, cover with geotextile fabric or wire screen (especially if concentrated flows are expected) to help keep berm in tack. Anchor fabric or wire by placing under the berm or use stakes.
3. Trenching is not required.

4. Berms should be spaced according to the steepness of the slope, with berms spaced closer together as the slope increases.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). If channels form through void spaces in the barrier, the barrier should be reconstructed to eliminate the channels. Ensure that sediment has not built up and that no damage has been done by vehicles. Regular inspection should indicate the frequency of sediment removal needed. Accumulated sediment should be removed from the uphill side of the barrier when sediment height reaches between 1/3 and 1/2 the height of the barrier. Sediment should be disposed of and the filter material and/or fabric should be replaced if necessary. It is important that repairs be performed at the first sign of deterioration to ensure that the berm is functioning properly.

Removal

Remove filter berms after uphill drainage areas are stabilized. Rock and brush may be left in place only if it does not cause any landscaping problems. Remove all manmade materials (wire, fabric and/or stakes).

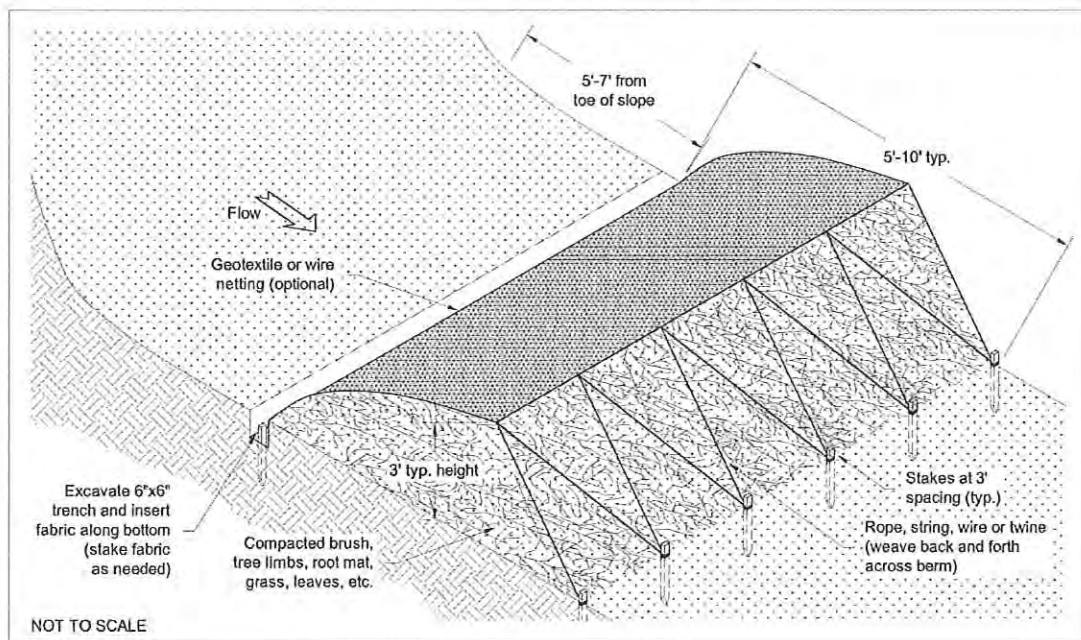
References

Environmental Protection Agency (EPA), *National Pollutant Discharge Elimination System (NPDES). Construction Site Storm Water Runoff Control*. Washington, D.C., February, 2003.

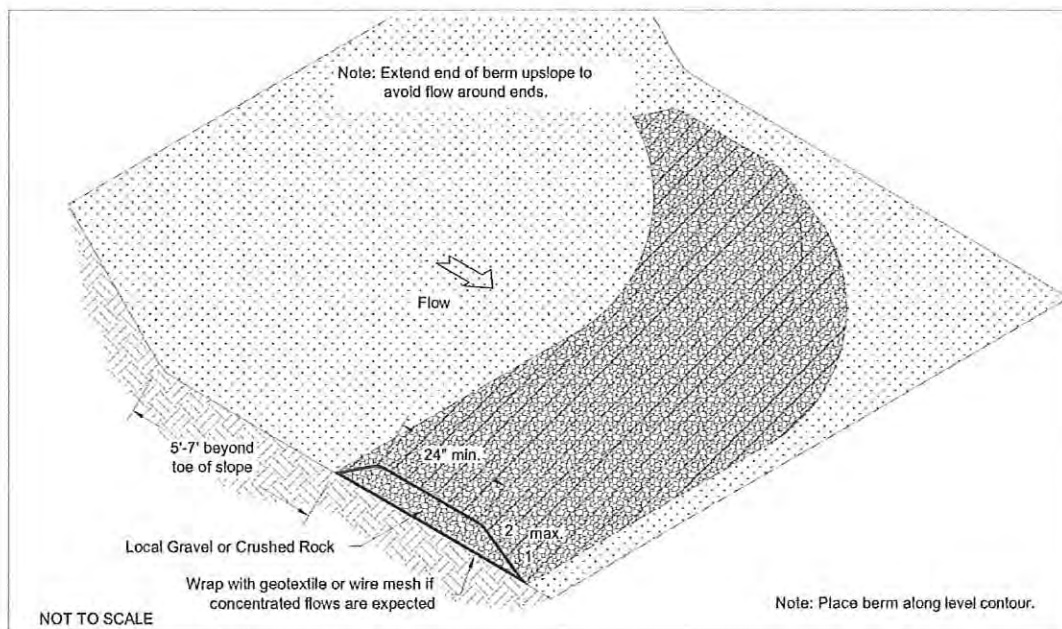
<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/con_site.cfm>

Horizon Environmental Services, Inc, *Guidance Document Reasonable and Prudent Practices for Stabilization (RAPPS) of Oil and Gas Construction Sites*. April 2004.

**Figure FB-1
Brush Filter Berm Installation**



**Figure FB-2
Rock Filter Berm Installation**



Description

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.



Photograph SB-1. Sediment basin at the toe of a slope. Photo courtesy of WWE.

Appropriate Uses

Most large construction sites (typically greater than 2 acres) will require one or more sediment basins for effective management of construction site runoff. On linear construction projects, sediment basins may be impractical; instead, sediment traps or other combinations of BMPs may be more appropriate.

Sediment basins should not be used as stand-alone sediment controls. Erosion and other sediment controls should also be implemented upstream.

When feasible, the sediment basin should be installed in the same location where a permanent post-construction detention pond will be located.

Design and Installation

The design procedure for a sediment basin includes these steps:

- **Basin Storage Volume:** Provide a storage volume of at least 3,600 cubic feet per acre of drainage area. To the extent practical, undisturbed and/or off-site areas should be diverted around sediment basins to prevent “clean” runoff from mixing with runoff from disturbed areas. For undisturbed areas (both on-site and off-site) that cannot be diverted around the sediment basin, provide a minimum of 500 ft³/acre of storage for undeveloped (but stable) off-site areas in addition to the 3,600 ft³/acre for disturbed areas. For stable, developed areas that cannot be diverted around the sediment basin, storage volume requirements are summarized in Table SB-1.
- **Basin Geometry:** Design basin with a minimum length-to-width ratio of 2:1 (L:W). If this cannot be achieved because of site space constraints, baffling may be required to extend the effective distance between the inflow point(s) and the outlet to minimize short-circuiting.
- **Dam Embankment:** It is recommended that embankment slopes be 4:1 (H:V) or flatter and no steeper than 3:1 (H:V) in any location.

Sediment Basins	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

- **Inflow Structure:** For concentrated flow entering the basin, provide energy dissipation at the point of inflow.

Table SB-1. Additional Volume Requirements for Undisturbed and Developed Tributary Areas Draining through Sediment Basins

Imperviousness (%)	Additional Storage Volume (ft³) Per Acre of Tributary Area
Undeveloped	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

- **Outlet Works:** The outlet pipe shall extend through the embankment at a minimum slope of 0.5 percent. Outlet works can be designed using one of the following approaches:
 - **Riser Pipe (Simplified Detail):** Detail SB-1 provides a simplified design for basins treating no more than 15 acres.
 - **Orifice Plate or Riser Pipe:** Follow the design criteria for Full Spectrum Detention outlets in the EDB Fact Sheet provided in Chapter 4 of this manual for sizing of outlet perforations with an emptying time of approximately 72 hours. In lieu of the trash rack, pack uniformly sized 1½ - to 2-inch gravel in front of the plate or surrounding the riser pipe. This gravel will need to be cleaned out frequently during the construction period as sediment accumulates within it. The gravel pack will need to be removed and disposed of following construction to reclaim the basin for use as a permanent detention facility. If the basin will be used as a permanent extended detention basin for the site, a trash rack will need to be installed once contributing drainage areas have been stabilized and the gravel pack and accumulated sediment have been removed.
 - **Floating Skimmer:** If a floating skimmer is used, install it using manufacturer's recommendations. Illustration SB-1 provides an illustration of a Faircloth Skimmer Floating Outlet™, one of the more commonly used floating skimmer outlets. A skimmer should be designed to release the design volume in no less than 48 hours. The use of a floating skimmer outlet can increase the sediment capture efficiency of a basin significantly. A floating outlet continually decants cleanest water off the surface of the pond and releases cleaner water than would discharge from a perforated riser pipe or plate.

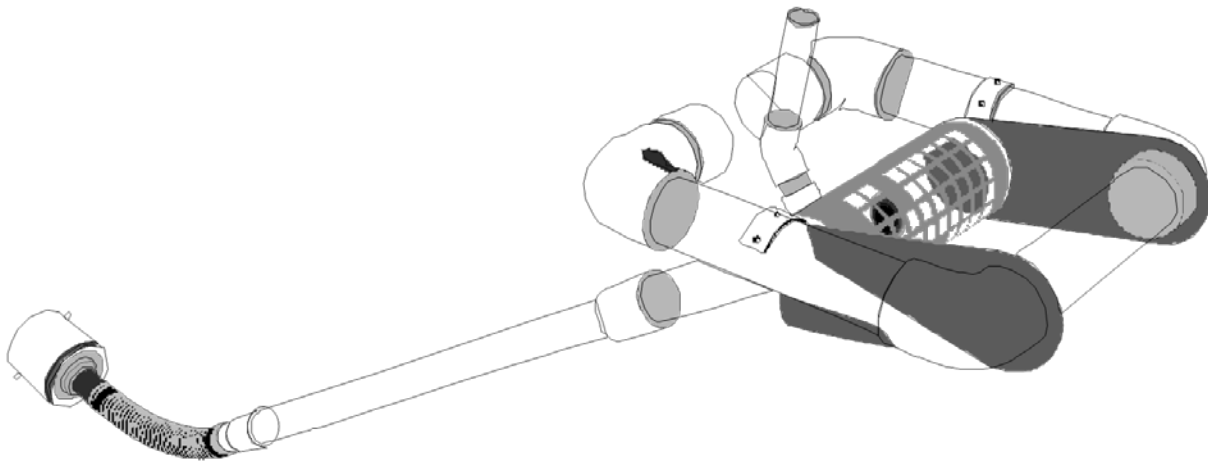


Illustration SB-1. Outlet structure for a temporary sediment basin - Faircloth Skimmer Floating Outlet. Illustration courtesy of J. W. Faircloth & Sons, Inc., FairclothSkimmer.com.

- **Outlet Protection and Spillway:** Consider all flow paths for runoff leaving the basin, including protection at the typical point of discharge as well as overtopping.
 - **Outlet Protection:** Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material of the waterway into which discharge occurs. This may require the use of a riprap apron at the outlet location and/or other measures to keep the waterway from eroding.
 - **Emergency Spillway:** Provide a stabilized emergency overflow spillway for rainstorms that exceed the capacity of the sediment basin volume and its outlet. Protect basin embankments from erosion and overtopping. If the sediment basin will be converted to a permanent detention basin, design and construct the emergency spillway(s) as required for the permanent facility. If the sediment basin will not become a permanent detention basin, it may be possible to substitute a heavy polyvinyl membrane or properly bedded rock cover to line the spillway and downstream embankment, depending on the height, slope, and width of the embankments.

Maintenance and Removal

Maintenance activities include the following:

- Dredge sediment from the basin, as needed to maintain BMP effectiveness, typically when the design storage volume is no more than one-third filled with sediment.
- Inspect the sediment basin embankments for stability and seepage.
- Inspect the inlet and outlet of the basin, repair damage, and remove debris. Remove, clean and replace the gravel around the outlet on a regular basis to remove the accumulated sediment within it and keep the outlet functioning.
- Be aware that removal of a sediment basin may require dewatering and associated permit requirements.
- Do not remove a sediment basin until the upstream area has been stabilized with vegetation.

Final disposition of the sediment basin depends on whether the basin will be converted to a permanent post-construction stormwater basin or whether the basin area will be returned to grade. For basins being converted to permanent detention basins, remove accumulated sediment and reconfigure the basin and outlet to meet the requirements of the final design for the detention facility. If the sediment basin is not to be used as a permanent detention facility, fill the excavated area with soil and stabilize with vegetation.

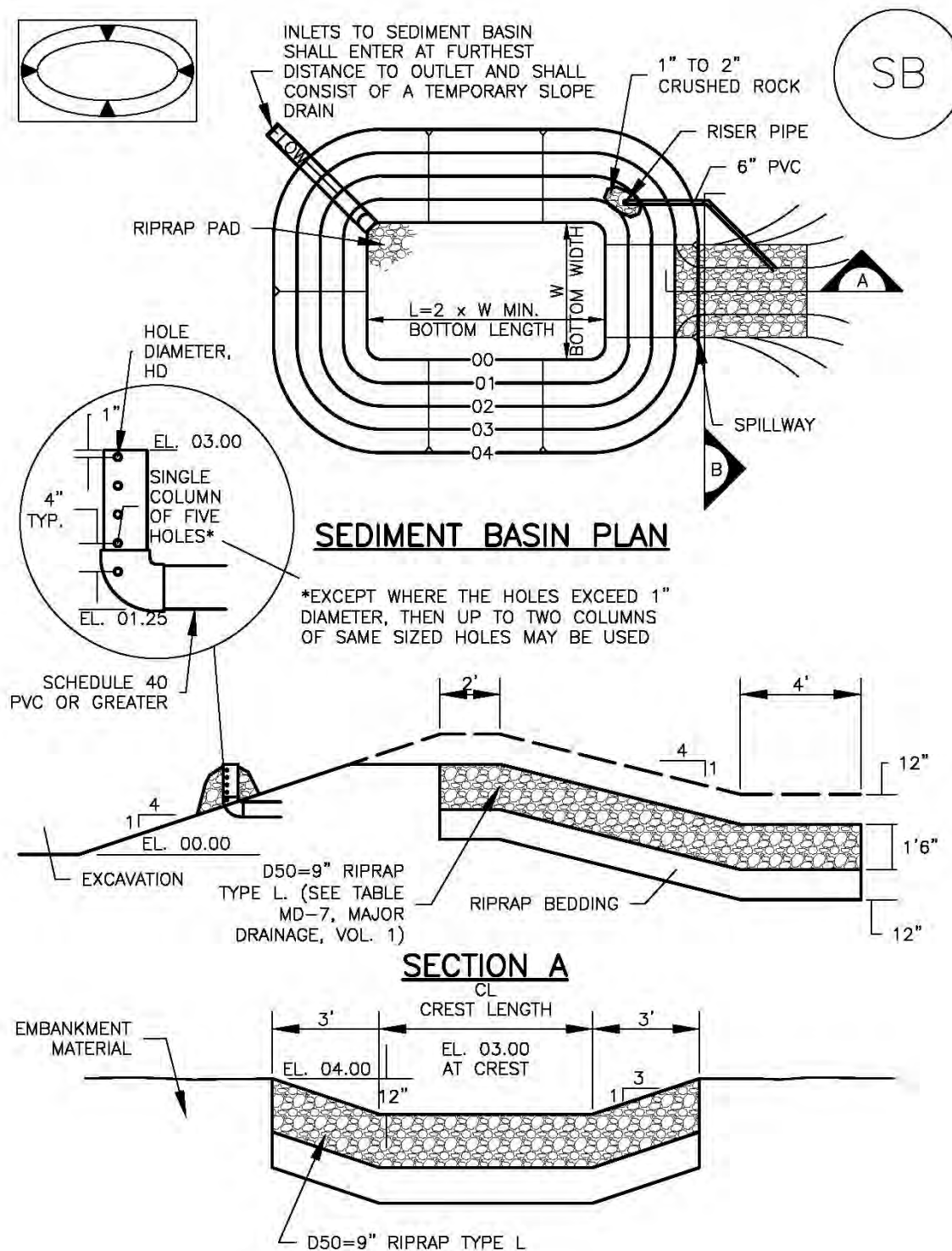


TABLE SB-1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 ½	2	9/32
2	21	3	13/16
3	28	5	½
4	33 ½	6	9/8
5	38 ½	8	2 1/32
6	43	9	2 1/32
7	47 ¼	11	2 5/32
8	51	12	2 7/32
9	55	13	7/8
10	58 ¼	15	1 5/16
11	61	16	3 1/32
12	64	18	1
13	67 ½	19	1 1/16
14	70 ½	21	1 1/8
15	73 ¼	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

- SEE PLAN VIEW FOR:
 - LOCATION OF SEDIMENT BASIN.
 - TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
 - FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
 - FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.
- FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.
- SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND-DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.
- EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.
- EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.
- PIPE SCH 40 OR GREATER SHALL BE USED.
- THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

SEDIMENT BASIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).
5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.
6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Sediment traps are formed by excavating an area or by placing an earthen embankment across a low area or drainage swale. Sediment traps are designed to capture drainage from disturbed areas less than one acre and allow settling of sediment.

Appropriate Uses

Sediment traps can be used in combination with other layers of erosion and sediment controls to trap sediment from small drainage areas (less than one acre) or areas with localized high sediment loading. For example, sediment traps are often provided in conjunction with vehicle tracking controls and wheel wash facilities.



Photograph ST-1. Sediment traps are used to collect sediment-laden runoff from disturbed area. Photo courtesy of EPA Menu of BMPs.

Design and Installation

A sediment trap consists of a small excavated basin with an earthen berm and a riprap outlet. The berm of the sediment trap may be constructed from the excavated material and must be compacted to 95 percent of the maximum density in accordance with ASTM D698. An overflow outlet must be provided at an elevation at least 6 inches below the top of the berm. See Detail ST-1 for additional design and installation information.

Maintenance and Removal

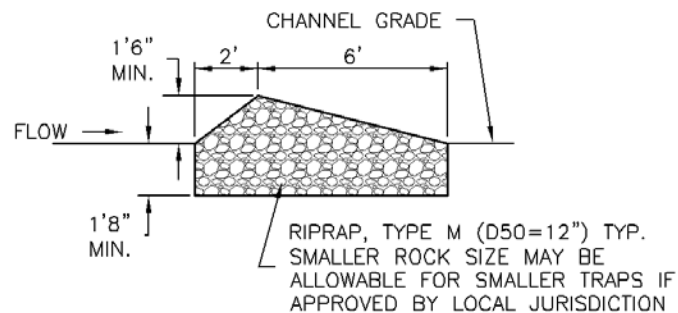
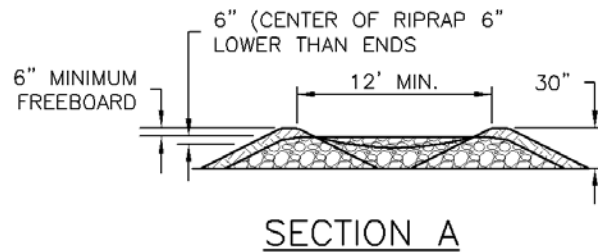
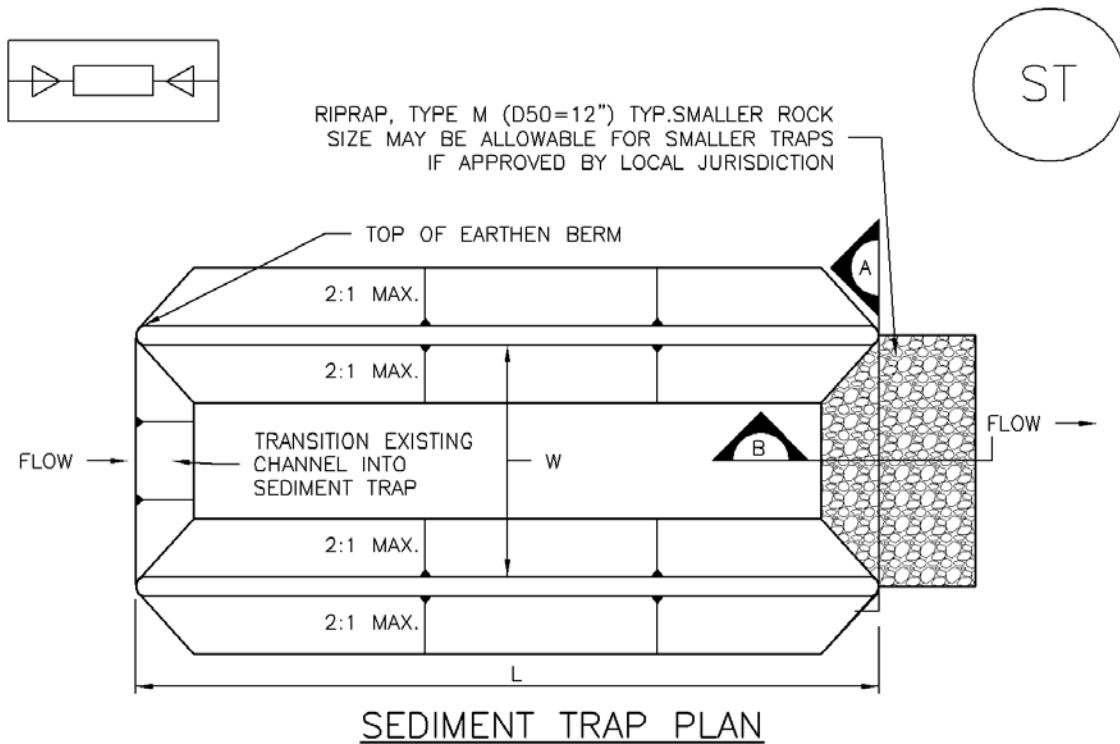
Inspect the sediment trap embankments for stability and seepage.

Remove accumulated sediment as needed to maintain the effectiveness of the sediment trap, typically when the sediment depth is approximately one-half the height of the outflow embankment.

Inspect the outlet for debris and damage. Repair damage to the outlet, and remove all obstructions.

A sediment trap should not be removed until the upstream area is sufficiently stabilized. Upon removal of the trap, the disturbed area should be covered with topsoil and stabilized.

Sediment Trap	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No



ST-1. SEDIMENT TRAP

SEDIMENT TRAP INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
-LOCATION, LENGTH AND WIDTH OF SEDIMENT TRAP.
2. ONLY USE FOR DRAINAGE AREAS LESS THAN 1 ACRE.
3. SEDIMENT TRAPS SHALL BE INSTALLED PRIOR TO ANY UPGRADE LAND-DISTURBING ACTIVITIES.
4. SEDIMENT TRAP BERM SHALL BE CONSTRUCTED FROM MATERIAL FROM EXCAVATION. THE BERM SHALL BE COMPACTED TO 95% OF THE MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.
5. SEDIMENT TRAP OUTLET TO BE CONSTRUCTED OF RIPRAP, TYPE M (D50=12") TYP. SMALLER ROCK SIZE MAY BE ALLOWABLE FOR SMALLER TRAPS IF APPROVED BY LOCAL JURISDICTION.
6. THE TOP OF THE EARTHEN BERM SHALL BE A MINIMUM OF 6" HIGHER THAN THE TOP OF THE RIPRAP OUTLET STRUCTURE.
7. THE ENDS OF THE RIPRAP OUTLET STRUCTURE SHALL BE A MINIMUM OF 6" HIGHER THAN THE CENTER OF THE OUTLET STRUCTURE.

SEDIMENT TRAP MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. REMOVE SEDIMENT ACCUMULATED IN TRAP AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE BMP, TYPICALLY WHEN THE SEDIMENT DEPTH REACHES $\frac{1}{2}$ THE HEIGHT OF THE RIPRAP OUTLET.
5. SEDIMENT TRAPS SHALL REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.
6. WHEN SEDIMENT TRAPS ARE REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

Buffer strips of preserved natural vegetation or grass help protect waterways and wetlands from land disturbing activities. Vegetated buffers improve stormwater runoff quality by straining sediment, promoting infiltration, and slowing runoff velocities.

Appropriate Uses

Vegetated buffers can be used to separate land disturbing activities and natural surface waters or conveyances.

In many jurisdictions, local governments require some type of setback from natural waterways. Concentrated flow should not be directed through a buffer; instead, runoff should be in the form of sheet flow. Vegetated buffers are typically used in combination with other perimeter control BMPs such as sediment control logs or silt fence for multi-layered protection.

Design and Installation

Minimum buffer widths may vary based on local regulations. Clearly delineate the boundary of the natural buffer area using construction fencing, silt fence, or a comparable technique. In areas that have been cleared and graded, vegetated buffers such as sod can also be installed to create or restore a vegetated buffer around the perimeter of the site.

Maintenance and Removal

Inspect buffer areas for signs of erosion such as gullies or rills. Stabilize eroding areas, as needed. If erosion is due to concentrated flow conditions, it may be necessary to install a level spreader or other technique to restore sheet flow conditions. Inspect perimeter controls delineating the vegetative buffer and repair or replace as needed.



Photograph VB-1. A vegetated buffer is maintained between the area of active construction and the drainage swale. Photo courtesy of WWE.

Vegetated Buffers	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	Yes

Description

Chemical treatment for erosion and sediment control can take several forms:

1. Applying chemicals to disturbed surfaces to reduce erosion (these uses are discussed in the Soil Binders Fact Sheet).
2. Adding flocculants to sedimentation ponds or tanks to enhance sediment removal prior.
3. Using proprietary barriers or flow-through devices containing flocculants (e.g., "floc logs").



Photograph CT-1. Proprietary chemical treatment system being used on a construction site with sensitive receiving waters. Photo courtesy of WVE.

The use of flocculants as described in No. 2 and No. 3 above will likely require special permitting. Check with the state permitting agency. See the Soil Binder BMP Fact Sheet for information on surface application of chemical treatments, as described in No. 1.

Appropriate Uses

At sites with fine-grained materials such as clays, chemical addition to sedimentation ponds or tanks can enhance settling of suspended materials through flocculation.

Prior to selecting and using chemical treatments, it is important to check state and local permit requirements related to their use.

Design and Installation

Due to variations among proprietary chemical treatment methods, design details are not provided for this BMP. Chemical feed systems for sedimentation ponds, settling tanks and dewatering bags should be installed and operated in accordance with manufacturer's recommendations and applicable regulations. Alum and chitosan are two common chemicals used as flocculants. Because the potential long-term impact of these chemicals to natural drainageways is not yet fully understood, the state does not currently allow chemical addition under the CDPS General Stormwater Construction Discharge Permit. Additional permitting may be necessary, which may include sampling requirements and numeric discharge limits.

Any devices or barriers containing chemicals should be installed following manufacturer's guidelines. Check for state and local jurisdiction usage restrictions and requirements before including these practices in the SWMP and implementing them onsite.

Chemical Treatment	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	No

Maintenance and Removal

Chemical feed systems for sedimentation ponds or tanks should be maintained in accordance with manufacturer's recommendations and removed when the systems are no longer being used. Accumulated sediment should be dried and disposed of either at a landfill or in accordance with applicable regulations.

Barriers and devices containing chemicals should be removed and replaced when tears or other damage to the devices are observed. These barriers should be removed and properly disposed of when the site has been stabilized.

Description

Effective construction site management to minimize erosion and sediment transport includes attention to construction phasing, scheduling, and sequencing of land disturbing activities. On most construction projects, erosion and sediment controls will need to be adjusted as the project progresses and should be documented in the SWMP.

Construction phasing refers to disturbing only part of a site at a time to limit the potential for erosion from dormant parts of a site. Grading activities and construction are completed and soils are effectively stabilized on one part of a site before grading and construction begins on another portion of the site.



Photograph CP-1. Construction phasing to avoid disturbing the entire area at one time. Photo courtesy of WWE.

Construction sequencing or scheduling refers to a specified work schedule that coordinates the timing of land disturbing activities and the installation of erosion and sediment control practices.

Appropriate Uses

All construction projects can benefit from upfront planning to phase and sequence construction activities to minimize the extent and duration of disturbance. Larger projects and linear construction projects may benefit most from construction sequencing or phasing, but even small projects can benefit from construction sequencing that minimizes the duration of disturbance.

Typically, erosion and sediment controls needed at a site will change as a site progresses through the major phases of construction. Erosion and sediment control practices corresponding to each phase of construction must be documented in the SWMP.

Design and Installation

BMPs appropriate to the major phases of development should be identified on construction drawings. In some cases, it will be necessary to provide several drawings showing construction-phase BMPs placed according to stages of development (e.g., clearing and grading, utility installation, active construction, final stabilization). Some municipalities in the Denver area set maximum sizes for disturbed area associated with phases of a construction project. Additionally, requirements for phased construction drawings vary among local governments within the UDFCD boundary. Some local governments require separate erosion and sediment control drawings for initial BMPs, interim conditions (in active construction), and final stabilization.

Construction Scheduling	
Functions	
Erosion Control	Moderate
Sediment Control	Moderate
Site/Material Management	Yes

Typical construction phasing BMPs include:

- Limit the amount of disturbed area at any given time on a site to the extent practical. For example, a 100-acre subdivision might be constructed in five phases of 20 acres each.
- If there is carryover of stockpiled material from one phase to the next, position carryover material in a location easily accessible for the pending phase that will not require disturbance of stabilized areas to access the stockpile. Particularly with regard to efforts to balance cut and fill at a site, careful planning for location of stockpiles is important.

Typical construction sequencing BMPs include:

- Sequence construction activities to minimize duration of soil disturbance and exposure. For example, when multiple utilities will occupy the same trench, schedule installation so that the trench does not have to be closed and opened multiple times.
- Schedule site stabilization activities (e.g., landscaping, seeding and mulching, installation of erosion control blankets) as soon as feasible following grading.
- Install initial erosion and sediment control practices before construction begins. Promptly install additional BMPs for inlet protection, stabilization, etc., as construction activities are completed.

Table CP-1 provides typical sequencing of construction activities and associated BMPs.

Maintenance and Removal

When the construction schedule is altered, erosion and sediment control measures in the SWMP and construction drawings should be appropriately adjusted to reflect actual "on the ground" conditions at the construction site. Be aware that changes in construction schedules can have significant implications for site stabilization, particularly with regard to establishment of vegetative cover.

Table CP-1. Typical Phased BMP Installation for Construction Projects

Project Phase	BMPs
Pre-disturbance, Site Access	<ul style="list-style-type: none"> Install sediment controls downgradient of access point (on paved streets this may consist of inlet protection). Establish vehicle tracking control at entrances to paved streets. Fence as needed. Use construction fencing to define the boundaries of the project and limit access to areas of the site that are not to be disturbed. <p>Note: it may be necessary to protect inlets in the general vicinity of the site, even if not downgradient, if there is a possibility that sediment tracked from the site could contribute to the inlets.</p>
Site Clearing and Grubbing	<ul style="list-style-type: none"> Install perimeter controls as needed on downgradient perimeter of site (silt fence, wattles, etc). Limit disturbance to those areas planned for disturbance and protect undisturbed areas within the site (construction fence, flagging, etc). Preserve vegetative buffer at site perimeter. Create stabilized staging area. Locate portable toilets on flat surfaces away from drainage paths. Stake in areas susceptible to high winds. Construct concrete washout area and provide signage. Establish waste disposal areas. Install sediment basins. Create dirt perimeter berms and/or brush barriers during grubbing and clearing. Separate and stockpile topsoil, leave roughened and/or cover. Protect stockpiles with perimeter control BMPs. Stockpiles should be located away from drainage paths and should be accessed from the upgradient side so that perimeter controls can remain in place on the downgradient side. Use erosion control blankets, temporary seeding, and/or mulch for stockpiles that will be inactive for an extended period. Leave disturbed area of site in a roughened condition to limit erosion. Consider temporary revegetation for areas of the site that have been disturbed but that will be inactive for an extended period. Water to minimize dust but not to the point that watering creates runoff.

Project Phase	BMPs
Utility And Infrastructure Installation	<p>In Addition to the Above BMPs:</p> <ul style="list-style-type: none"> ▪ Close trench as soon as possible (generally at the end of the day). ▪ Use rough-cut street control or apply road base for streets that will not be promptly paved. ▪ Provide inlet protection as streets are paved and inlets are constructed. ▪ Protect and repair BMPs, as necessary. ▪ Perform street sweeping as needed.
Building Construction	<p>In Addition to the Above BMPs:</p> <ul style="list-style-type: none"> ▪ Implement materials management and good housekeeping practices for home building activities. ▪ Use perimeter controls for temporary stockpiles from foundation excavations. ▪ For lots adjacent to streets, lot-line perimeter controls may be necessary at the back of curb.
Final Grading	<p>In Addition to the Above BMPs:</p> <ul style="list-style-type: none"> ▪ Remove excess or waste materials. ▪ Remove stored materials.
Final Stabilization	<p>In Addition to the Above BMPs:</p> <ul style="list-style-type: none"> ▪ Seed and mulch/tackify. ▪ Seed and install blankets on steep slopes. ▪ Remove all temporary BMPs when site has reached final stabilization.

Description

Protection of existing vegetation on a construction site can be accomplished through installation of a construction fence around the area requiring protection. In cases where upgradient areas are disturbed, it may also be necessary to install perimeter controls to minimize sediment loading to sensitive areas such as wetlands. Existing vegetation may be designated for protection to maintain a stable surface cover as part of construction phasing, or vegetation may be protected in areas designated to remain in natural condition under post-development conditions (e.g., wetlands, mature trees, riparian areas, open space).



Photograph PV-1. Protection of existing vegetation and a sensitive area. Photo courtesy of CDOT.

Appropriate Uses

Existing vegetation should be preserved for the maximum practical duration on a construction site through the use of effective construction phasing. Preserving vegetation helps to minimize erosion and can reduce revegetation costs following construction.

Protection of wetland areas is required under the Clean Water Act, unless a permit has been obtained from the U.S. Army Corps of Engineers (USACE) allowing impacts in limited areas.

If trees are to be protected as part of post-development landscaping, care must be taken to avoid several types of damage, some of which may not be apparent at the time of injury. Potential sources of injury include soil compaction during grading or due to construction traffic, direct equipment-related injury such as bark removal, branch breakage, surface grading and trenching, and soil cut and fill. In order to minimize injuries that may lead to immediate or later death of the tree, tree protection zones should be developed during site design, implemented at the beginning of a construction project, as well as continued during active construction.

Design and Installation

General

Once an area has been designated as a preservation area, there should be no construction activity allowed within a set distance of the area. Clearly mark the area with construction fencing. Do not allow stockpiles, equipment, trailers or parking within the protected area. Guidelines to protect various types of existing vegetation follow.

Protection of Existing Vegetation	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	Yes

Surface Cover During Phased Construction

Install construction fencing or other perimeter controls around areas to be protected from clearing and grading as part of construction phasing.

Maintaining surface cover on steep slopes for the maximum practical duration during construction is recommended.

Open Space Preservation

Where natural open space areas will be preserved as part of a development, it is important to install construction fencing around these areas to protect them from compaction. This is particularly important when areas with soils with high infiltration rates are preserved as part of LID designs. Preserved open space areas should not be used for staging and equipment storage.

Wetlands and Riparian Areas

Install a construction fence around the perimeter of the wetland or riparian (streamside vegetation) area to prevent access by equipment. In areas downgradient of disturbed areas, install a perimeter control such as silt fence, sediment control logs, or similar measure to minimize sediment loading to the wetland.

Tree Protection¹

- Before beginning construction operations, establish a tree protection zone around trees to be preserved by installing construction fences. Allow enough space from the trunk to protect the root zone from soil compaction and mechanical damage, and the branches from mechanical damage (see Table PV-1). If low branches will be kept, place the fence outside of the drip line. Where this is not possible, place fencing as far away from the trunk as possible. In order to maintain a healthy tree, be aware that about 60 percent of the tree's root zone extends beyond the drip line.

Table PV-1
Guidelines for Determining the Tree Protection Zone
 (Source: Matheny and Clark, 1998; as cited in GreenCO and WWE 2008)

Species Tolerance to Damage	Distance from Trunk (ft) per inch of DBH		
	<i>Young</i>	<i>Mature</i>	<i>Over mature</i>
<i>Good</i>	0.5'	0.75'	1.0'
<i>Moderate</i>	0.75'	1.0'	1.25'
<i>Poor</i>	1.0'	1.25'	1.5'
Notes: DBH = diameter at breast height (4.5 ft above grade); Young = <20% of life expectancy; Mature = 20%-80% of life expectancy; Over mature =>80% of life expectancy			

- Most tree roots grow within the top 12 to 18 inches of soil. Grade changes within the tree protection zone should be avoided where possible because seemingly minor grade changes can either smother

¹ Tree Protection guidelines adapted from GreenCO and WWE (2008). *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability, Third Release*. See www.greenco.org for more detailed guidance on tree preservation.

roots (in fill situations) or damage roots (in cut situations). Consider small walls where needed to avoid grade changes in the tree protection zone.

- Place and maintain a layer of mulch 4 to 6-inch thick from the tree trunk to the fencing, keeping a 6-inch space between the mulch and the trunk. Mulch helps to preserve moisture and decrease soil compaction if construction traffic is unavoidable. When planting operations are completed, the mulch may be reused throughout planting areas.
- Limit access, if needed at all, and appoint one route as the main entrance and exit to the tree protection zone. Within the tree protection zone, do not allow any equipment to be stored, chemicals to be dumped, or construction activities to take place except fine grading, irrigation system installation, and planting operations. These activities should be conducted in consultation with a landscaping professional, following Green Industry BMPs.
- Be aware that soil compaction can cause extreme damage to tree health that may appear gradually over a period of years. Soil compaction is easier to prevent than repair.

Maintenance and Removal

Repair or replace damaged or displaced fencing or other protective barriers around the vegetated area.

If damage occurs to a tree, consult an arborist for guidance on how to care for the tree. If a tree in a designated preservation area is damaged beyond repair, remove and replace with a 2-inch diameter tree of the same or similar species.

Construction equipment must not enter a wetland area, except as permitted by the U.S. Army Corps of Engineers (USACE). Inadvertent placement of fill in a wetland is a 404 permit violation and will require notification of the USACE.

If damage to vegetation occurs in a protected area, reseed the area with the same or similar species, following the recommendations in the USDCM *Revegetation* chapter.

Description

A construction fence restricts site access to designated entrances and exits, delineates construction site boundaries, and keeps construction out of sensitive areas such as natural areas to be preserved as open space, wetlands and riparian areas.

Appropriate Uses

A construction fence can be used to delineate the site perimeter and locations within the site where access is restricted to protect natural resources such as wetlands, waterbodies, trees, and other natural areas of the site that should not be disturbed.



Photograph CF-1. A construction fence helps delineate areas where existing vegetation is being protected. Photo courtesy of Douglas County.

If natural resource protection is an objective, then the construction fencing should be used in combination with other perimeter control BMPs such as silt fence, sediment control logs or similar measures.

Design and Installation

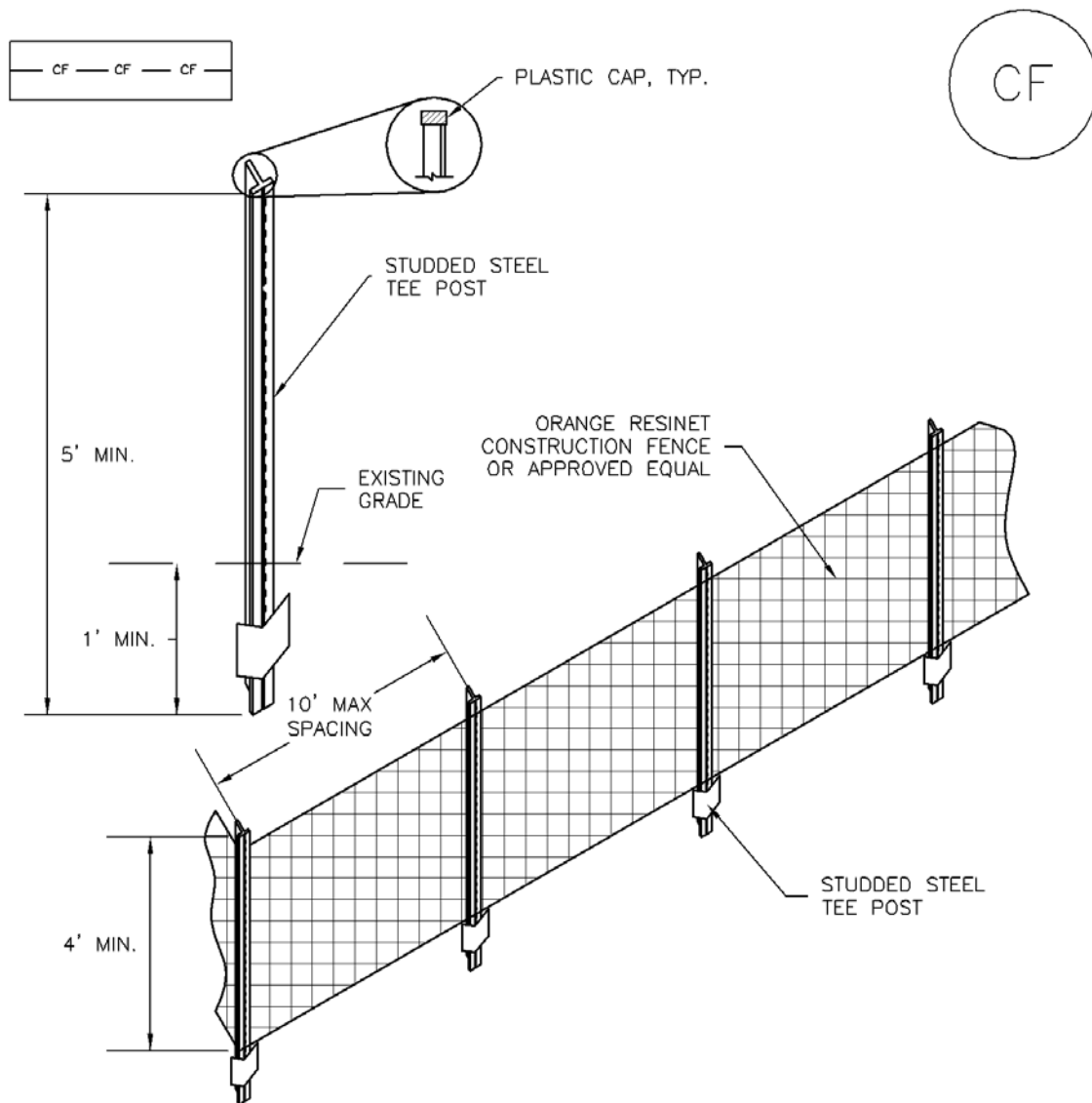
Construction fencing may be chain link or plastic mesh and should be installed following manufacturer's recommendations. See Detail CF-1 for typical installations.

Do not place construction fencing in areas within work limits of machinery.

Maintenance and Removal

- Inspect fences for damage; repair or replace as necessary.
- Fencing should be tight and any areas with slumping or fallen posts should be reinstalled.
- Fencing should be removed once construction is complete.

Construction Fence	
Functions	
Erosion Control	No
Sediment Control	No
Site/Material Management	Yes



CF-1. PLASTIC MESH CONSTRUCTION FENCE

CONSTRUCTION FENCE INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
-LOCATION OF CONSTRUCTION FENCE.
2. CONSTRUCTION FENCE SHOWN SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.
3. CONSTRUCTION FENCE SHALL BE COMPOSED OF ORANGE, CONTRACTOR-GRADE MATERIAL THAT IS AT LEAST 4' HIGH. METAL POSTS SHOULD HAVE A PLASTIC CAP FOR SAFETY.
4. STUDDED STEEL TEE POSTS SHALL BE UTILIZED TO SUPPORT THE CONSTRUCTION FENCE. MAXIMUM SPACING FOR STEEL TEE POSTS SHALL BE 10'.
5. CONSTRUCTION FENCE SHALL BE SECURELY FASTENED TO THE TOP, MIDDLE, AND BOTTOM OF EACH POST.

CONSTRUCTION FENCE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. CONSTRUCTION FENCE SHALL BE REPAIRED OR REPLACED WHEN THERE ARE SIGNS OF DAMAGE SUCH AS RIPS OR SAGS. CONSTRUCTION FENCE IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.
5. WHEN CONSTRUCTION FENCES ARE REMOVED, ALL DISTURBED AREAS ASSOCIATED WITH THE INSTALLATION, MAINTENANCE, AND/OR REMOVAL OF THE FENCE SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED, OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD)

Description

Vehicle tracking controls provide stabilized construction site access where vehicles exit the site onto paved public roads. An effective vehicle tracking control helps remove sediment (mud or dirt) from vehicles, reducing tracking onto the paved surface.

Appropriate Uses

Implement a stabilized construction entrance or vehicle tracking control where frequent heavy vehicle traffic exits the construction site onto a paved roadway. An effective vehicle tracking control is particularly important during the following conditions:

- Wet weather periods when mud is easily tracked off site.
- During dry weather periods where dust is a concern.
- When poorly drained, clayey soils are present on site.

Although wheel washes are not required in designs of vehicle tracking controls, they may be needed at particularly muddy sites.

Design and Installation

Construct the vehicle tracking control on a level surface. Where feasible, grade the tracking control towards the construction site to reduce off-site runoff. Place signage, as needed, to direct construction vehicles to the designated exit through the vehicle tracking control. There are several different types of stabilized construction entrances including:

VTC-1. Aggregate Vehicle Tracking Control. This is a coarse-aggregate surfaced pad underlain by a geotextile. This is the most common vehicle tracking control, and when properly maintained can be effective at removing sediment from vehicle tires.

VTC-2. Vehicle Tracking Control with Construction Mat or Turf Reinforcement Mat. This type of control may be appropriate for site access at very small construction sites with low traffic volume over vegetated areas. Although this application does not typically remove sediment from vehicles, it helps protect existing vegetation and provides a stabilized entrance.



Photograph VTC-1. A vehicle tracking control pad constructed with properly sized rock reduces off-site sediment tracking.

Vehicle Tracking Control	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	Yes

VTC-3. Stabilized Construction Entrance/Exit with Wheel Wash. This is an aggregate pad, similar to VTC-1, but includes equipment for tire washing. The wheel wash equipment may be as simple as hand-held power washing equipment to more advance proprietary systems. When a wheel wash is provided, it is important to direct wash water to a sediment trap prior to discharge from the site.

Vehicle tracking controls are sometimes installed in combination with a sediment trap to treat runoff.

Maintenance and Removal

Inspect the area for degradation and replace aggregate or material used for a stabilized entrance/exit as needed. If the area becomes clogged and ponds water, remove and dispose of excess sediment or replace material with a fresh layer of aggregate as necessary.

With aggregate vehicle tracking controls, ensure rock and debris from this area do not enter the public right-of-way.

Remove sediment that is tracked onto the public right of way daily or more frequently as needed. Excess sediment in the roadway indicates that the stabilized construction entrance needs maintenance.

Ensure that drainage ditches at the entrance/exit area remain clear.

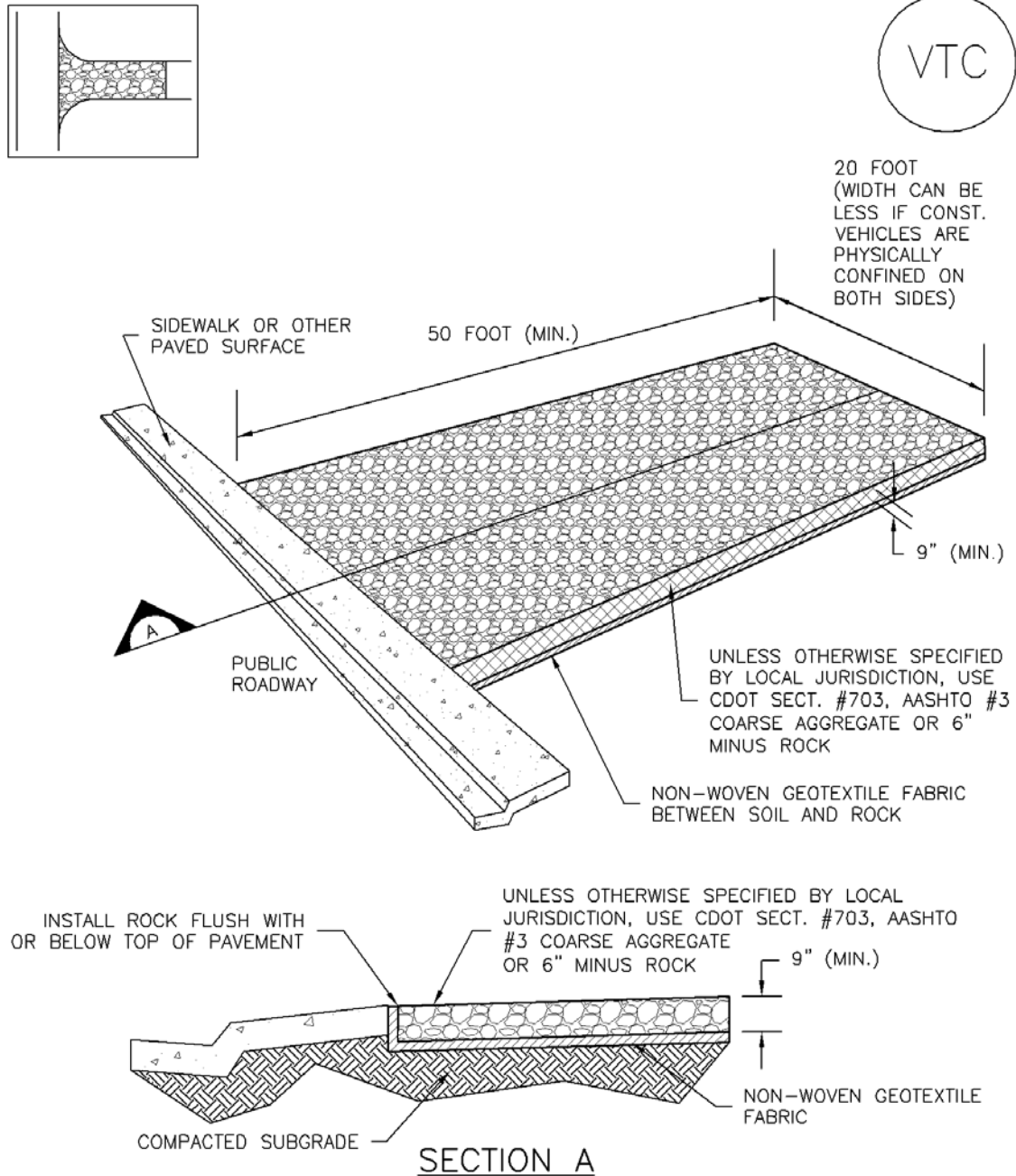
A stabilized entrance should be removed only when there is no longer the potential for vehicle tracking to occur. This is typically after the site has been stabilized.

When wheel wash equipment is used, be sure that the wash water is discharged to a sediment trap prior to discharge. Also inspect channels conveying the water from the wash area to the sediment trap and stabilize areas that may be eroding.

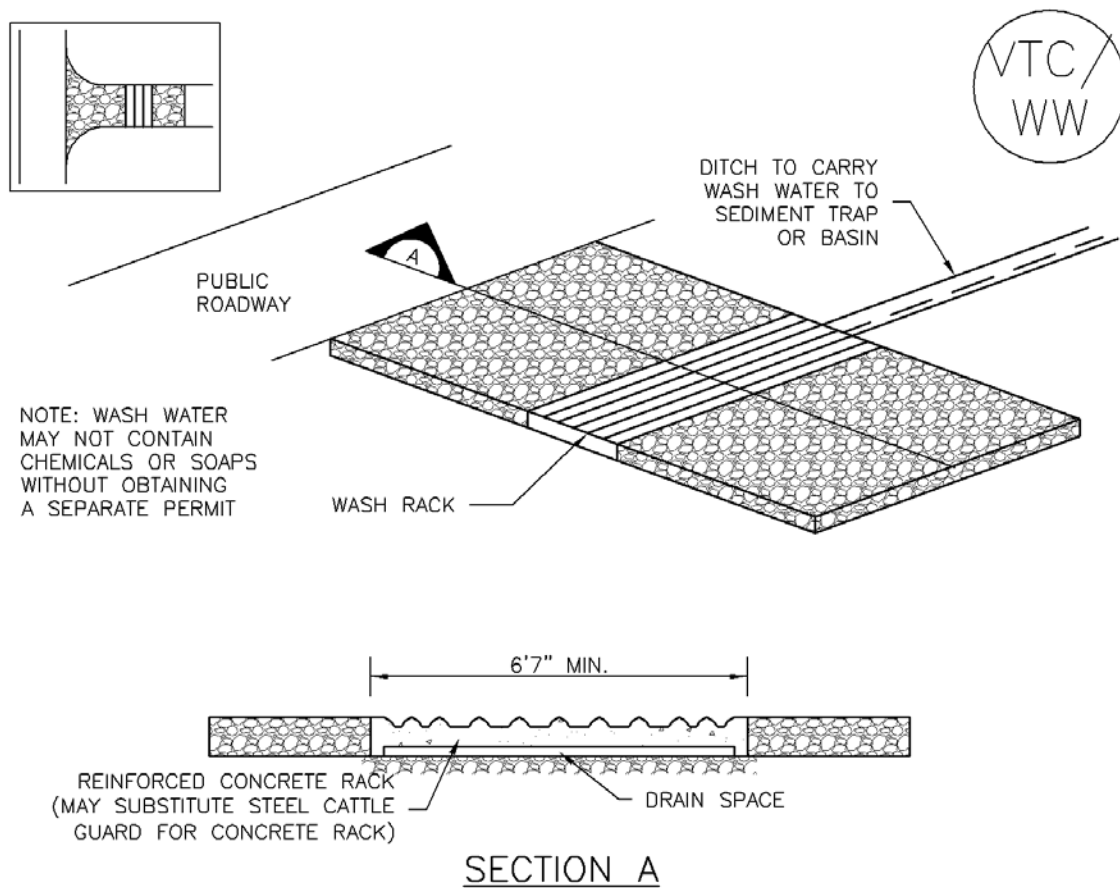
When a construction entrance/exit is removed, excess sediment from the aggregate should be removed and disposed of appropriately. The entrance should be promptly stabilized with a permanent surface following removal, typically by paving.



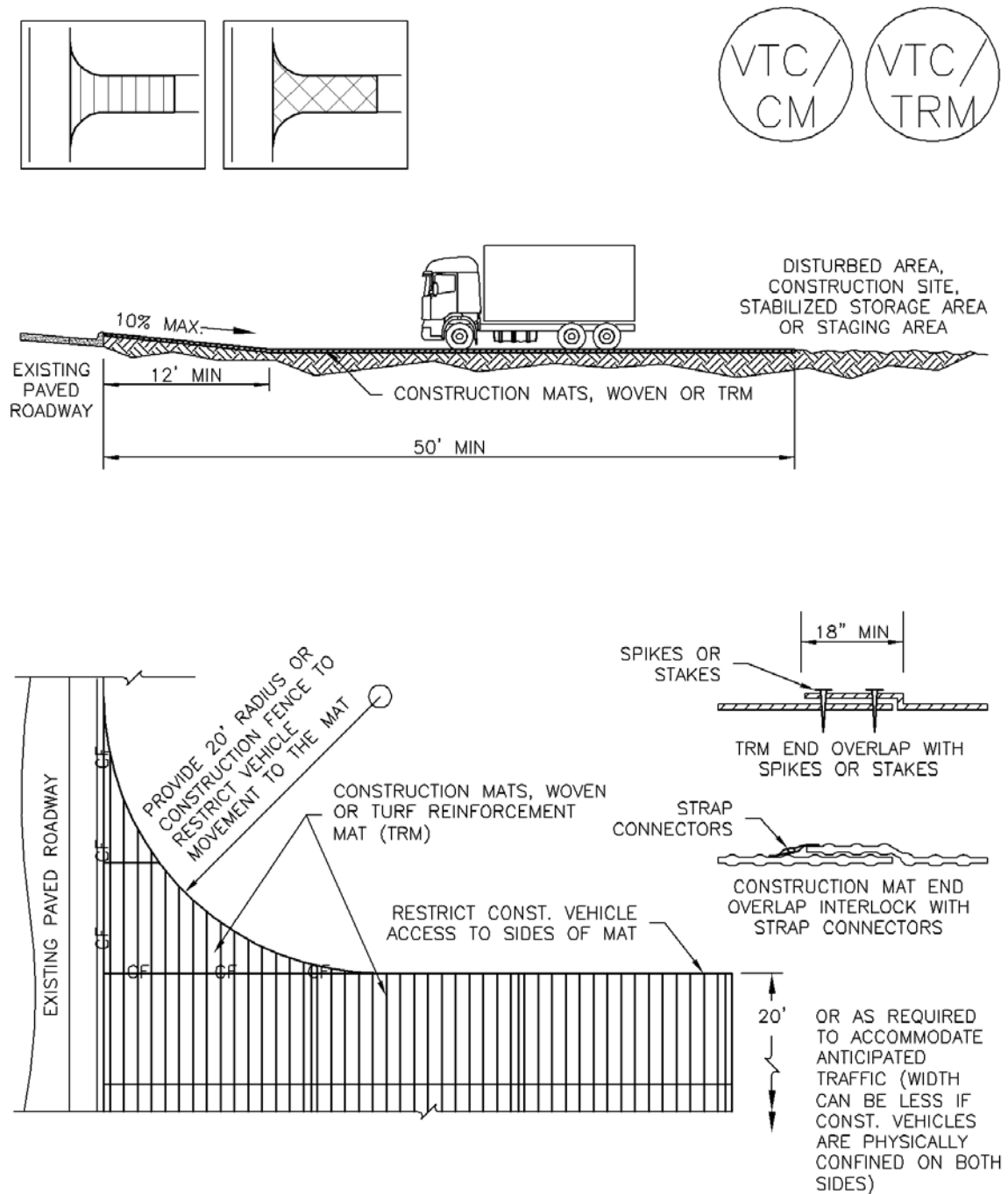
Photograph VTC-2. A vehicle tracking control pad with wheel wash facility. Photo courtesy of Tom Gore.



VTC-1. AGGREGATE VEHICLE TRACKING CONTROL



VTC-2. AGGREGATE VEHICLE TRACKING CONTROL WITH
WASH RACK



VTC-3. VEHICLE TRACKING CONTROL W/ CONSTRUCTION MAT OR TURF REINFORCEMENT MAT (TRM)

STABILIZED CONSTRUCTION ENTRANCE/EXIT INSTALLATION NOTES

1. SEE PLAN VIEW FOR
 - LOCATION OF CONSTRUCTION ENTRANCE(S)/EXIT(S).
 - TYPE OF CONSTRUCTION ENTRANCE(S)/EXITS(S) (WITH/WITHOUT WHEEL WASH, CONSTRUCTION MAT OR TRM).
2. CONSTRUCTION MAT OR TRM STABILIZED CONSTRUCTION ENTRANCES ARE ONLY TO BE USED ON SHORT DURATION PROJECTS (TYPICALLY RANGING FROM A WEEK TO A MONTH) WHERE THERE WILL BE LIMITED VEHICULAR ACCESS.
3. A STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE LOCATED AT ALL ACCESS POINTS WHERE VEHICLES ACCESS THE CONSTRUCTION SITE FROM PAVED RIGHT-OF-WAYS.
4. STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.
5. A NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED UNDER THE STABILIZED CONSTRUCTION ENTRANCE/EXIT PRIOR TO THE PLACEMENT OF ROCK.
6. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

STABILIZED CONSTRUCTION ENTRANCE/EXIT MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY TO THE STABILIZED ENTRANCE/EXIT TO MAINTAIN A CONSISTENT DEPTH.
5. SEDIMENT TRACKED ONTO PAVED ROADS IS TO BE REMOVED THROUGHOUT THE DAY AND AT THE END OF THE DAY BY SHOVELING OR SWEEPING. SEDIMENT MAY NOT BE WASHED DOWN STORM SEWER DRAINS.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM CITY OF BROOMFIELD, COLORADO, NOT AVAILABLE IN AUTOCAD)

Description

A stabilized construction roadway is a temporary method to control sediment runoff, vehicle tracking, and dust from roads during construction activities.

Appropriate Uses

Use on high traffic construction roads to minimize dust and erosion.

Stabilized construction roadways are used instead of rough-cut street controls on roadways with frequent construction traffic.



Photograph SCR-1. Stabilized construction roadway.

Design and Installation

Stabilized construction roadways typically involve two key components: 1) stabilizing the road surface with an aggregate base course of 3-inch-diameter granular material and 2) stabilizing roadside ditches, if applicable. Early application of road base is generally suitable where a layer of coarse aggregate is specified for final road construction.

Maintenance and Removal

Apply additional gravel as necessary to ensure roadway integrity.

Inspect drainage ditches along the roadway for erosion and stabilize, as needed, through the use of check dams or rolled erosion control products.

Gravel may be removed once the road is ready to be paved. Prior to paving, the road should be inspected for grade changes and damage. Regrade and repair as necessary.

Stabilized Construction Roadway	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	Yes

Description

A stabilized staging area is a clearly designated area where construction equipment and vehicles, stockpiles, waste bins, and other construction-related materials are stored. The contractor office trailer may also be located in this area. Depending on the size of the construction site, more than one staging area may be necessary.

Appropriate Uses

Most construction sites will require a staging area, which should be clearly designated in SWMP drawings. The layout of the staging area may vary depending on the type of construction activity. Staging areas located in roadways due to space constraints require special measures to avoid materials being washed into storm inlets.



Photograph SSA-1. Example of a staging area with a gravel surface to prevent mud tracking and reduce runoff. Photo courtesy of Douglas County.

Design and Installation

Stabilized staging areas should be completed prior to other construction activities beginning on the site. Major components of a stabilized staging area include:

- Appropriate space to contain storage and provide for loading/unloading operations, as well as parking if necessary.
- A stabilized surface, either paved or covered, with 3-inch diameter aggregate or larger.
- Perimeter controls such as silt fence, sediment control logs, or other measures.
- Construction fencing to prevent unauthorized access to construction materials.
- Provisions for Good Housekeeping practices related to materials storage and disposal, as described in the Good Housekeeping BMP Fact Sheet.
- A stabilized construction entrance/exit, as described in the Vehicle Tracking Control BMP Fact Sheet, to accommodate traffic associated with material delivery and waste disposal vehicles.

Over-sizing the stabilized staging area may result in disturbance of existing vegetation in excess of that required for the project. This increases costs, as well as requirements for long-term stabilization following the construction period. When designing the stabilized staging area, minimize the area of disturbance to the extent practical.

Stabilized Staging Area	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material	Yes

Minimizing Long-Term Stabilization Requirements

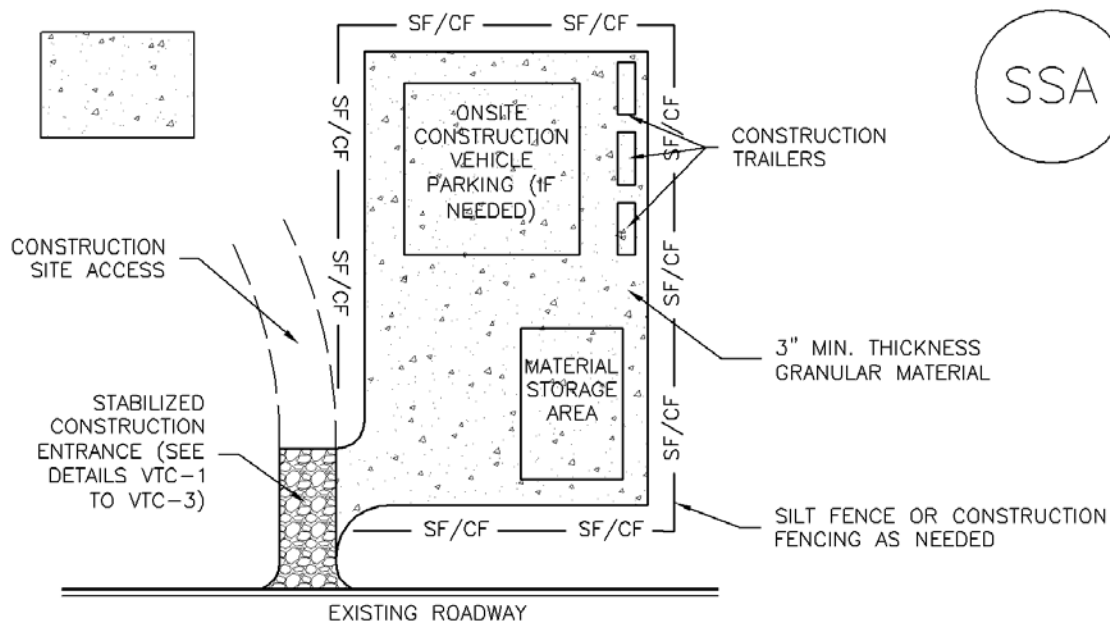
- Utilize off-site parking and restrict vehicle access to the site.
- Use construction mats in lieu of rock when staging is provided in an area that will not be disturbed otherwise.
- Consider use of a bermed contained area for materials and equipment that do not require a stabilized surface.
- Consider phasing of staging areas to avoid disturbance in an area that will not be otherwise disturbed.

See Detail SSA-1 for a typical stabilized staging area and SSA-2 for a stabilized staging area when materials staging in roadways is required.

Maintenance and Removal

Maintenance of stabilized staging areas includes maintaining a stable surface cover of gravel, repairing perimeter controls, and following good housekeeping practices.

When construction is complete, debris, unused stockpiles and materials should be recycled or properly disposed. In some cases, this will require disposal of contaminated soil from equipment leaks in an appropriate landfill. Staging areas should then be permanently stabilized with vegetation or other surface cover planned for the development.



SSA-1. STABILIZED STAGING AREA

STABILIZED STAGING AREA INSTALLATION NOTES

1. SEE PLAN VIEW FOR
 - LOCATION OF STAGING AREA(S).
 - CONTRACTOR MAY ADJUST LOCATION AND SIZE OF STAGING AREA WITH APPROVAL FROM THE LOCAL JURISDICTION.
2. STABILIZED STAGING AREA SHOULD BE APPROPRIATE FOR THE NEEDS OF THE SITE. OVERSIZING RESULTS IN A LARGER AREA TO STABILIZE FOLLOWING CONSTRUCTION.
3. STAGING AREA SHALL BE STABILIZED PRIOR TO OTHER OPERATIONS ON THE SITE.
4. THE STABILIZED STAGING AREA SHALL CONSIST OF A MINIMUM 3" THICK GRANULAR MATERIAL.
5. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.
6. ADDITIONAL PERIMETER BMPs MAY BE REQUIRED INCLUDING BUT NOT LIMITED TO SILT FENCE AND CONSTRUCTION FENCING.

STABILIZED STAGING AREA MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY IF RUTTING OCCURS OR UNDERLYING SUBGRADE BECOMES EXPOSED.

STABILIZED STAGING AREA MAINTENANCE NOTES

5. STABILIZED STAGING AREA SHALL BE ENLARGED IF NECESSARY TO CONTAIN PARKING, STORAGE, AND UNLOADING/LOADING OPERATIONS.

6. THE STABILIZED STAGING AREA SHALL BE REMOVED AT THE END OF CONSTRUCTION. THE GRANULAR MATERIAL SHALL BE REMOVED OR, IF APPROVED BY THE LOCAL JURISDICTION, USED ON SITE, AND THE AREA COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

NOTE: MANY MUNICIPALITIES PROHIBIT THE USE OF RECYCLED CONCRETE AS GRANULAR MATERIAL FOR STABILIZED STAGING AREAS DUE TO DIFFICULTIES WITH RE-ESTABLISHMENT OF VEGETATION IN AREAS WHERE RECYCLED CONCRETE WAS PLACED.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

Land Grading (LG)

SM-7



Description

Grading involves reshaping the ground surface to planned grades as determined by an engineering survey, evaluation, and layout. Grading provides more suitable topography for well pads and pipelines and helps to control surface runoff, soil erosion, and sedimentation during and after construction in these areas. This BMP shall include the following:

- Proper cut and fill techniques to ensure roads and well pads remain stable over time.
- Road crowning or sloping to properly route runoff off the roadway.
- Surfacing of roads or well pads with gravel to avoid mud, rutting, and large quantities of sediment that will wash away during storms.

Applicability

- This BMP is applicable to the construction and maintenance of any road or well pad, but particularly those located on steep topography or easily erodible soils.
- Surface gravel is applicable to all areas with “soft” sections, steep grades, highly erosive soils, or where all-weather access is needed. Gravel may be used as “fill” material in ruts or as a full structural section over the entire road or well pad.

Limitations

- Improper cut and fill slopes that disrupt natural storm water patterns might lead to poor drainage, high runoff velocities, and increased peak flows during storm events.
- Rutting and washboarding may develop if surface gravel is not designed properly or if road or well pad is not sloped.
- Flat-blading to maintain the roadway must be done properly to avoid changes in gravel thickness, road slope, and road grade.

Design Criteria

Grading Plan

A grading plan should be prepared that establishes the extent to which the road or well pad will be graded, how drainage patterns will be directed, and how runoff velocities will affect receiving waters. The grading plan also includes information regarding when earthwork will start and stop, establishes the degree and length of finished slopes, and dictates where and how excess material will be disposed of (or where borrow materials will be obtained if needed). Practices must be developed for erosion control, slope stabilization, and safe disposal of runoff water and drainage, such as ditches and culverts, grade stabilization structures, retaining walls, and surface drains. Berms, roadside ditches, and other storm water practices that require excavation and filling also should be incorporated into the grading plan.

Land grading should be based upon well pad and pipeline layouts that fit and utilize existing topography and desirable natural surroundings to avoid extreme grade modifications. Clearing and grading should only occur at those areas necessary for well pad activities and equipment traffic. Maintaining undisturbed temporary or permanent buffer zones in the grading operation provides a low-cost sediment control measure that will help reduce runoff and off-site sedimentation.

Slope Failures

Landslides and failed cuts and fills can be a major source of sediment, they can close the roads or require major repairs, and they can greatly increase maintenance costs. Slope failures, or landslides, typically occur where a slope is over-steep, where fill material is not compacted, or where cuts in natural soils encounter groundwater or zones of weak material. Good road location can often avoid landslide areas and reduce slope failures. When failures do occur, the slide area should be stabilized by removing the slide material, flattening the slope, adding drainage, or using structures, as discussed below. Designs are typically site specific and may require input from geotechnical engineers and engineering geologists. Failures that occur typically impact operations and can be costly to repair. Failures near streams and channel crossings have an added risk of impact to water quality.

Road Slope

See Figure LG-1. All roads should be designed with one of the following three slope types:

- Outslowed roads minimize the concentration of water and minimize road width by avoiding the need for an inside ditch, but may require roadway surface and fill slope stabilization. Outslowed roads with clay rich, slippery road surface materials often require surface stabilization with gravel or limited use during rainy periods to assure traffic safety. On road grades over 10 to 12 percent and on steep hill slope areas, outslowed roads are difficult to drain and can feel unsafe.
- Insloped roads are the best method to control surface water. However, insloped roads also concentrate water and require a system of ditches and turnouts or cross-draining culverts.
- Crowned roads are appropriate for higher standard, two lane roads on gentle grades. They may or may not require roadside ditches, turnouts, and/or cross-drains. It is difficult to create and maintain a crown on a narrow road, so generally insloped or outslowed road drainage is more effective.

Construction Specifications

Cut and Fill Slopes

1. All applicable perimeter erosion and sediment control practices and measures (berms, diversions, silt fence, or wattles) shall be constructed prior to any grading activities, and maintained in accordance with this BMP and the SWMP. Perimeter controls should remain in place until all graded or disturbed areas, including slopes, are adequately stabilized.
2. All areas to be disturbed (both cut and fill) shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material.
3. Fill material shall be free of brush, logs, stumps, roots, or other objectionable materials that would interfere with, or prevent, construction of satisfactory fills. This material can be set aside and later used at the toe of fill slopes as filter berms. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.
4. Table LG-1 presents a range of commonly used cut and fill slope ratios appropriate for the soil and rock types described. Figures LG-2 and LG-3 present typical cut slope and fill slope design options for varying slope and site conditions. Vertical cut slopes should not be used unless the cut is in rock or very well cemented soil. Ideally, both cut and fill slopes should be constructed with a 2:1 or flatter slope to promote growth of vegetation, but

cut slopes in dense, sterile soils or rocky material are often difficult to vegetate.

5. All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence, or other related problems.
6. Topsoil required for the establishment of vegetation shall be stockpiled in the amount necessary to complete finished grading of all exposed areas. Areas that are to be topsoiled shall be scarified to a minimum depth of four inches prior to placement of topsoil.
7. All graded cut and fill areas shall be stabilized, either structurally or vegetatively, immediately following finished grading. Some common slope stabilization options include hydroseeding, hydromulching, erosion control blankets, riprap, and retaining walls.

Road Slope

1. See Figure LG-1. Compact soil or road base material to direct runoff.
2. If crowning a road, runoff is directed to both sides of the road requiring two roadside ditches, unless runoff will drain directly to well stabilized areas.
3. If using an inslope design, runoff is directed toward the hillside and requires a roadside ditch with periodic turnouts or cross drain culvert installation.
4. If using an outslope design, ensure a moderate road slope with dense vegetative cover.

Surface Gravel

1. Gradation of gravel should be according to Figure LG-4. This figure shows the typical gradation ranges of aggregates used in construction, how the materials, ranging from coarse to fine, best perform, and the approximate limitations to the desirable gradation ranges. Ideally, aggregate surfacing material is (1) hard, durable, and crushed or screened to a minus 2 inch size; (2) well graded to achieve maximum density; (3) contains 5-15% clayey binder to prevent raveling; and (4) has a Plasticity Index of 2 to 10.
2. Gravel should be placed to a thickness of at least twice the diameter of the largest stone with a minimum thickness of four inches. Over very weak soils gravel thickness can be reduced with the use of geotextile or geogrid subgrade reinforcement. Also, geotextile layers are useful over soft soils to separate the gravel from the soil, keep it uncontaminated, and extend the useful life of the gravel.

3. Compact the aggregate during construction and maintenance to achieve a dense, smooth surface and thus reduce the amount of water that can soak into the road or well pad.
4. "Spot" stabilize local wet areas and soft areas with four to six inches of coarse rocky material. Add more rock as needed.
5. Blend coarse aggregate and fine clay-rich soil (when available) to produce a desirable composite roadway material that is coarse yet well-graded with 5-15 % fines for binder.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Inspect cut and fill slopes for rills or other indications of erosion. Maintain all crowns, outslopes, inslopes, and surface gravel.

The road surface and shoulders should be periodically smoothed and reshaped with a grader blade (flat-blading). This should be done when the gravel is moist. Maintain the proper road slope and grade while flat-blading. Also be sure to avoid plugging roadside ditches or altering adjacent drainage structures, as this may cause them to not function properly. Flat-blading may also cause road gravel to be pushed off the main roadway and onto the shoulders. To avoid this, blade toward the center of the road.

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Table LG-1
Stable Slope Ratios for Various Conditions

Soil/Rock Condition	Slope Ratio (Hor:Vert)
Most rock	¼:1 to ½:1
Very well cemented soils	¼:1 to ½:1
Most in-place soils	¾:1 to 1:1
Very fractured rock	1:1 to 1 ½: 1
Loose coarse granular soils	1 ½: 1
Heavy clay soils	2:1 to 3:1
Soft clay rich zones or wet seepage areas	2:1 to 3:1
Fills of most soils	1 ½:1 to 2:1
Fills of hard, angular rock	1 1/3 :1
Low cuts and fills (<10 ft high)	2:1 or flatter (for revegetation)

Figure LG-1
Typical Road Surface Drainage Options

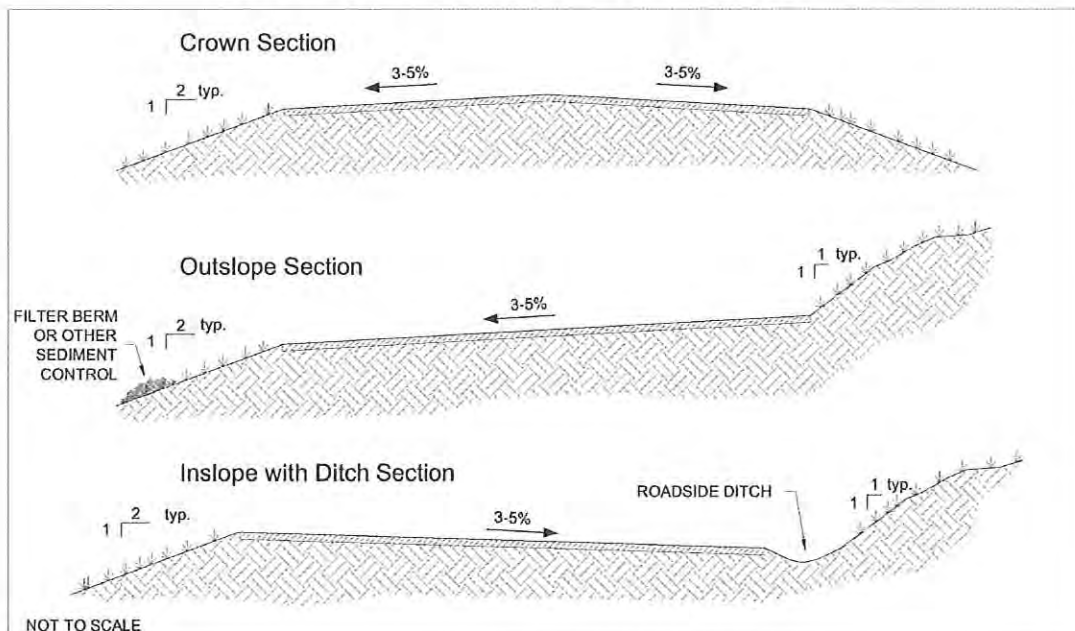
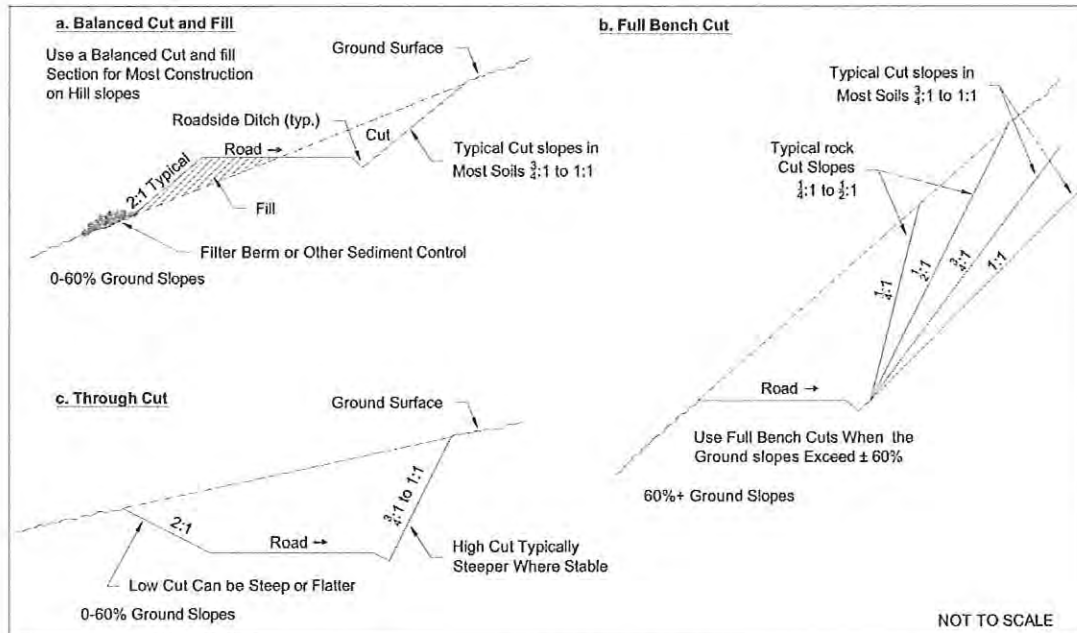
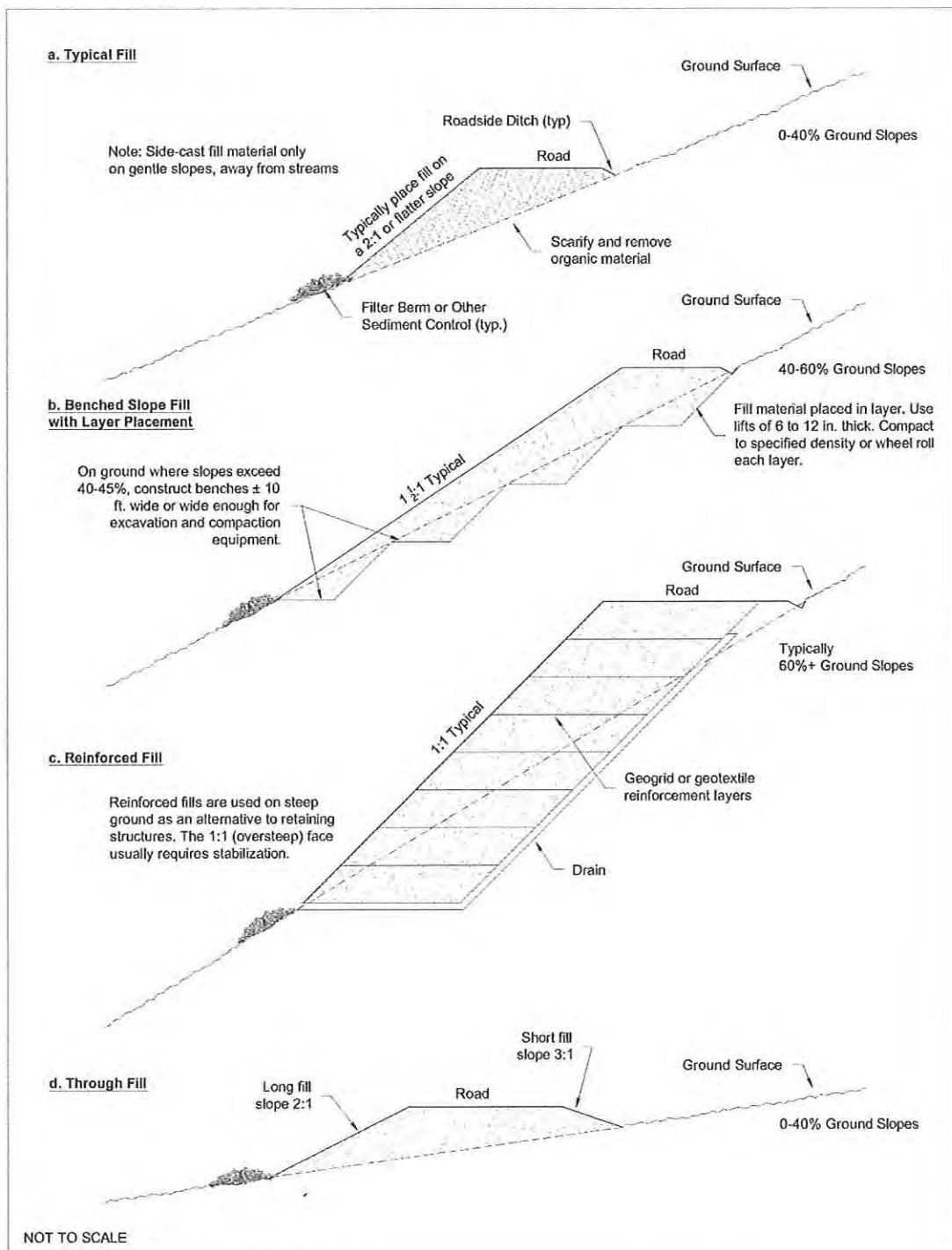


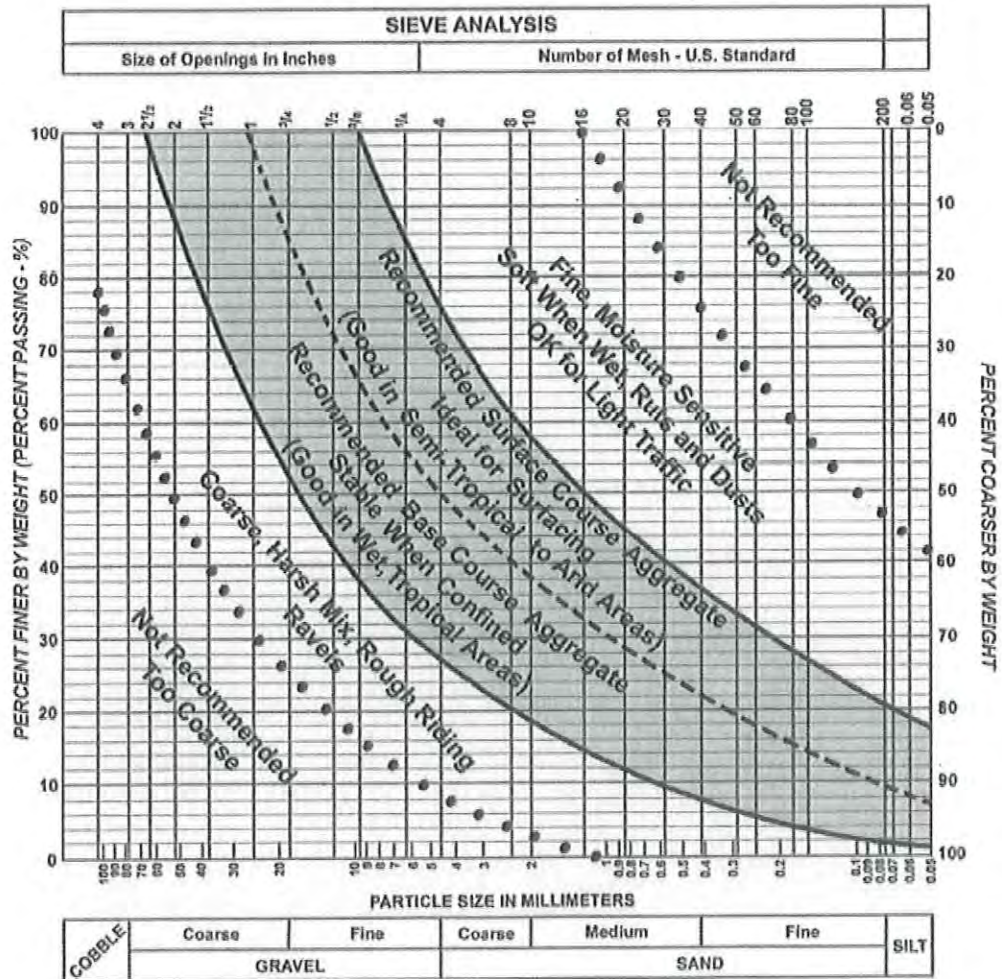
Figure LG-2 Cut Slope Design Options



**Figure LG-3
Fill Slope Design Options**



**Figure LG-4
Gradation and Performance of
Gravel Surfacing Materials**



NOTE: Gradation Ranges Shown Are Approximate.

Description

Temporary diversion methods are used to reroute water from a stream or restrict flows to a designated portion of the stream channel to allow for construction activities to take place in the stream, along the banks or beneath the active channel. Temporary diversion methods are often required during the construction of detention ponds, dams, in-stream grade control structures, utility installation and other activities, including maintenance, that require working in waterways. Temporary diversion methods include temporary diversion channels, pump-arounds, piped diversions, coffer dams and other similar practices. The primary purpose of all temporary diversion methods is to protect water quality by passing upstream flows around the active construction zone.



Photograph TDM-1. This coffer dam, installed to allow grading and stabilization of the stream bank, consists of concrete blocks covered by an impermeable liner held in place by sand bags.

Appropriate Uses

Temporary diversion methods are appropriate in situations when it is necessary to divert the flow around the area where work is being conducted. Temporary diversion methods vary with the size of the waterway that is being diverted.

For large streams, a temporary diversion may consist of berms or coffer dams constructed within the stream to confine flow to one side of the stream while work progresses on the “dry” side of the berm. For smaller streams and often for construction of dams and detention basins, a temporary diversion method may divert the entire waterway. For short duration projects (typically less than a month of active construction) with low baseflows, a pump and/or bypass pipe may serve as a temporary diversion. Whenever a temporary diversion is used, construction should be scheduled during drier times of the year (November through March) to the extent feasible, and construction in the waterway should progress as quickly as practical to reduce the risk of exceeding the temporary diversion capacity. Timing and duration of construction are primary considerations for determining the design flow most appropriate for a diversion. A sizing method that does not consider these variables is overly simplistic and can result in inflated project costs and land disturbances that provide little to no water quality benefit. Additionally, disturbing more area than necessary can result in increased erosion.

Temporary Diversion Channel	
Functions	
Erosion Control	Yes
Sediment Control	No
Site/Material Management	No

Temporary diversion method section and approach should occur on a project- and site-specific basis. For short duration projects (typically associated with maintenance of utilities and stream crossings and minor repairs to outfalls and eroded banks) constructed during dry times of the year, diversion construction can create greater disturbance and mobilization of sediment than all of the other earth disturbing activities of the project combined, and the cost of the diversion could be a significant percentage of the overall project cost. If it can be reasonably determined, based on area and duration of disturbance, that channel work will result in less disturbance and movement of sediment than would occur through installation of a temporary diversion, it is reasonable to exempt these activities from the requirement to construct a temporary diversion.

On the other end of the spectrum, a basis of design for a temporary diversion in excess of the methodology presented in this Fact Sheet may be appropriate for longer duration projects and/or projects where the consequences of exceeding diversion capacity are significant in terms of public safety, damage to infrastructure and property, environmental impacts, damage or delay to the project and other factors. In short, engineers should recognize that temporary diversions must be thoughtfully analyzed on a case-by-case basis, considering site-specific circumstances.

Design Considerations

Selection and design of temporary diversion methods should consider many factors, including:

- Will construction of a temporary diversion cause greater environmental impacts than if the project is constructed without a temporary diversion? This frequently applies to short duration, small scale projects associated with maintenance activities such as bank erosion repair, drop structure and pond maintenance, outfall improvements/repair and other limited construction activities.
- Size of stream, tributary watershed area and anticipated flow rates during construction. Special consideration should be given to large streams with large tributary areas with higher flow rates since the sizing methodology presented in this Fact Sheet is based on data from watersheds less than 20 square miles.
- Any special water quality or aquatic life conditions the waterway.
- Nature of surrounding land use, property ownership, and easements in the project area are important considerations in determining feasibility and methods for temporary diversions. For example, in a highly urbanized setting or an area with limited right-of-way, there may not be adequate space to construct a diversion channel.
- Seasonal variations in stream hydrology (baseflow vs. peak flow).
 - Irrigation flows: If an irrigation ditch enters the stream, it is recommended that the ditch company be contacted to confirm when flows from the ditch may be expected.
 - Weather (storm runoff): If diversions are constructed in summer months when thunderstorms and flash flooding can occur, contractors will need to track weather forecasts closely and provide additional protection when higher flows from runoff are anticipated. The UDFCD Alert System can be used for daily forecasts and to provide warnings for severe weather.
- Probability of flood flows exceeding diversion capacity and/or diversion failure. Consider the consequences of exceedance or failure such as:
 - Public safety
 - Environmental
 - Legal
 - Regulatory
 - Economic
 - Project disruption/delay
- Realistic estimation of project duration and time of year during which construction will occur.

- Comparison of the overall project costs to the temporary diversion costs (design and construction) and determining the costs and benefits of different diversion strategies relative to the protection that they provide.
- Permitting requirements for overall project and for diversion methods (United States Army Corps of Engineers, United States Fish and Wildlife Service, Colorado Department of Public Health and Environment, Federal Emergency Management Agency, Division of Water Resources, local governments, and others). Permit requirements and existing vegetative cover may limit the allowable area disturbance.
- Public safety aspects. For example, if a pipeline is being used, consideration should be given to public access and inlet protection.
- Legal considerations, which are a function of many different factors such as property ownership, history of localized flooding, or parties that will have interest in project.

Design and Installation

1. Determine if a diversion is appropriate based on appropriate uses and design considerations stated earlier. As noted, in some cases, constructing a project under wet conditions is preferable to constructing a temporary diversion to create dry conditions, especially if construction of the temporary diversion will require a significant amount of disturbance relative to the overall project.
2. Determine project duration.
 - “Long duration” projects are projects that last longer than three months and in many cases are Capital Improvement Projects or traditional land development projects.
 - “Short duration” projects are projects that are completed within one month or less and generally are associated with maintenance and repair activities.
 - “Interim duration” projects are projects that will last longer than one month but up to three months.
3. Determine the time of year in which construction will occur.
4. Gather necessary temporary diversion sizing parameters that may include tributary area, imperviousness, project duration safety factor, and seasonal sizing coefficient.
5. Apply applicable sizing methodology and perform necessary calculations (provided following this section). Use engineering judgment to determine if the temporary diversion design flow is adequate for the specific project.
6. Determine appropriate method of diversion. Follow the design steps for the selected method discussed below.
 - Channel Diversion – For smaller streams, construction of dams and detention basins, or as the site allows, a channel diversion may divert the entire waterway as illustrated in Figure TDM-1.

- Berm or Cofferdam – A berm or coffer dam is appropriate for streams of all sizes to confine flow to one side of the stream.
- Piped Diversion – A bypass pipe is generally appropriate for short duration projects with low baseflows.
- Pumped Diversion – A pumped diversion may be appropriate for short duration projects with low baseflows. It may also be the only option where space for the diversion is limited as shown in photograph TDM-2.

Selecting a Diversion Method

Selection of the appropriate diversion type is largely site specific. The best choice represents the most efficient method while keeping disturbance to a minimum.

7. Consider developing an emergency action plan, as a precaution, for rapidly removing equipment and materials with potential to contribute pollutants to runoff from the waterway in advance of imminent runoff with the potential to exceed diversion capacity. The emergency action plan should designate an individual who will be on the site throughout most of the construction project with the authority to order that work be halted and equipment and materials with potential to contribute to stormwater pollution be moved to high ground outside of the active channel. The emergency action plan should identify where equipment and materials removed from the channel will be stored temporarily during a runoff event that is expected to exceed temporary diversion capacity. The UDFCD Alert System and warnings of the potential for severe weather issued by UDFCD should be consulted daily during construction.

Channel Diversion

1. Use sizing methodology to determine temporary diversion design flow rate.
2. Determine channel slope based on existing and proposed site conditions.

Perform initial channel sizing calculations using Manning's Equation. Determine maximum permissible velocities based on lining material. Pay particular attention to diversion channel entrance, bends, transitions and downstream return to stream where scour forces may require greater protection. Unlined channels should not be used. Table TDM-1 gives Manning's "n" values for the most commonly used lining materials.

Because temporary diversion channels typically are not in service long enough to establish adequate vegetative lining, they must be designed to be stable for the design flow with the channel shear stress less than the critical tractive shear stress for the channel lining material.

3. Determine the channel geometry and check the capacity using Manning's Equation and the "n" value given in Table TDM-1. The steepest side slope allowable is two horizontal to one vertical (2:1), unless vertical walls are installed using sheet piling, concrete or stacked stone. Consideration for public access and safety should be accounted for when determining channel geometry.
4. Determine depth of flow. A maximum depth of 1-foot is allowed for flows less than 20 cfs and a maximum of 3 feet for flows less than 100 cfs. (Flows in excess of 100 cfs should be designed in accordance with the *Major Drainage* chapter in Volume 1). Provide a minimum of 0.5 feet of freeboard above the design water surface elevation.

Table TDM-1. Manning's n Values for Temporary Diversion Channel Design

Lining Material	Manning's n Depth = 0 to 1.0 ft	Manning's n Depth = 1.0 to 3.0 ft	Manning's n Depth = 3.0 to 5.0 ft
Plastic Membrane	0.011	0.010	0.009
Straw/Curled Wood Mats	0.035	0.025	0.020
Riprap, Type VL	0.070	0.045	0.035
Riprap, Type L	0.100	0.070	0.040
Riprap, Type M	0.125	0.075	0.045

Note: Use manufacturer's Manning's n when available. See the *Major Drainage* chapter of the USDCM for riprap gradation. Erosion protection should extend a minimum of 0.5 feet above the design water depth.

Berm or Cofferd Dam

For coffer dams or berms that are intended to isolate a portion of the stream from the work area steps 1-4 should be applied to the "wet" side of the coffer dam or berm.

1. Use sizing methodology to determine temporary diversion design flow rate.
2. Determine channel slope based on existing and proposed site conditions.
3. Perform initial channel sizing calculations using Manning's Equation. Determine maximum permissible velocities based on lining material. Because temporary diversion measures typically are not in service long enough to establish adequate vegetative lining, they must be designed to be stable for the design flow with the channel shear stress less than the critical tractive shear stress for the channel lining material. This stability criterion applies to the stream-side of berms when berms are used to isolate a work area within a stream.
4. Determine the channel geometry and check the capacity using Manning's Equation and the "n" value given in Table TDM-1. The steepest side slope allowable is two horizontal to one vertical (2:1), unless vertical walls are installed using sheet piling, concrete or stacked stone. Provide a minimum of 0.5 feet of freeboard above the design water surface elevation.

Piped Diversion

1. Use sizing methodology to determine temporary diversion design flow rate.
2. Size the pipe to accommodate the design flow using no more than 80 percent of the pipe full flow capacity. Select a Manning's n value based on the type of pipe material that will be used (concrete n = 0.013 [typ.], corrugated metal pipe n = 0.024 [typ.]).

Pumped Diversion

1. Use sizing methodology to determine temporary diversion design flow rate.
2. A backup pump (or pumps) with capacity equal to or greater than the diversion design flow rate should be on site and in good working order at all times.

Sizing Methodology

The methodology for sizing of temporary diversion methods was developed using baseflow observations and Crest Stage Indicator (CSI) peak flow data collected from 21 watersheds within the UDFCD boundary. These data were collected over extended periods of time (up to 31 years) and, as a result, provide a sound statistical basis for the sizing methodology.

Determine sizing procedure to use based on the project duration.

- “Long duration” projects last longer than three months and in many cases are Capital Improvement Projects or traditional land development projects.
- “Short duration” projects are completed within one month or less and generally are associated with maintenance and repair activities. For these projects, it is recommended that the temporary diversion be sized based on the statistics identified for baseflows (i.e., vs. peak flows) and be of sufficient size to convey a flow that has a less than 50% chance of being exceeded between November – March, including a project duration safety factor.
- “Interim duration” projects will last longer than one month but up to three months. In these projects, engineering judgment must be applied, drawing on sizing methods for “short duration” and “long duration” project criteria and the time of year of construction to develop a basis of design for the temporary diversion method that is appropriate for the project.

It is highly recommended that projects involving temporary diversions be constructed between November and March. If a short duration project requiring a temporary diversion must be conducted between April and October, the extended weather forecast should be evaluated to avoid periods of anticipated precipitation and a conservative safety factor should be applied. Additional protection may need to be provided for the site if higher flows from runoff are anticipated.



Photograph TDM-2. Despite a relatively significant baseflow, a pumped diversion was selected for this Lakewood Gulch project due to a lack of space crossing Federal Boulevard. Photo courtesy of City and County of Denver.

“Long duration” projects last longer than three months.

“Short duration” projects are completed within one month or less.

“Interim duration” projects last longer than one month and up to three months.

Sizing Procedure for Long Duration Projects (duration greater than three months)

1. Determine the tributary drainage area, A , in square miles.
2. Determine the watershed imperviousness (adjusted as appropriate for disconnected impervious area, see Chapter 3).
3. Determine the design peak flow rate according to Figure TDM-2. Note: For long duration projects, or where the consequences of diversion failure warrant, a larger design flow may be necessary, and/or a more detailed, site-specific hydrologic analysis.

Figure TDM-2 may be used to estimate the design discharge for the sizing of temporary diversion methods for projects exceeding three months in duration. The curves in this figure were originally developed using annual peak flow data collected from 17 watersheds within the UDFCD boundary and then updated in 2012 using annual peak flow data from 21 watersheds with CSI gages. These data were collected over extended periods of time (up to 31 years) and, as a result, provide a sound statistical basis for the figure. The data supporting Figure TDM-2 were taken during the high flood potential period of April through September.

Figure TDM-2 provides estimated 2-year peak flow rates with the upper 5% and lower 95% confidence limits shown and is based on watershed imperviousness for small waterways (25 square miles or less).¹ Because Figure TDM-2 was developed using data from small watersheds, it is not appropriate to extrapolate from this figure for larger, more complex watersheds. For larger waterways (e.g., South Platte River, Sand Creek, Bear Creek, etc.), including ones controlled by flood control reservoirs (e.g., Chatfield Dam, Cherry Creek Dam, etc.), site-specific hydrologic analysis and risk assessment will be necessary to evaluate the appropriate level of protection to be provided by the temporary diversion. For any size watershed, it is important that the designer understand watershed characteristics to determine applicability of the simplified method and how these characteristics influence the choice of diversion method. It is also important to recognize that larger floods can and do occur. It is the responsibility of the designer and the contractor to assess their risk of having the temporary diversion being exceeded and to evaluate the damages such an event may cause to the project, adjacent properties and others.

¹ There are a multitude of factors affecting rainfall-runoff response of a watershed in addition to impervious area. Other factors include soil types, total area, fraction of connected/disconnected impervious area, watershed shape, topography and many other factors). Figure TDM-2 provides a simplified design tool based on watershed imperviousness but should not be blindly relied upon without due consideration of other factors including those listed above and others.

Sizing Procedure for Short Duration Projects (one month or less of active construction)

1. Determine the tributary drainage area, A , in square miles.
2. Select a safety factor, S , based on project duration from Table TDM-2. Short duration projects have been broken down further into projects less than two weeks and projects from two weeks up to one month.
3. Select the sizing coefficient, K , corresponding to the month in which the project will occur (see Table TDM-2). For projects that span two months with different K values, use the greater of the two K values. For short duration projects that will occur during the traditionally dry period of the year (November through March) a K value of 0.2 is recommended. For short duration projects that will occur April through October, and wet weather is not predicted, a K value of 0.5 is recommended.

When a diversion is determined to be appropriate, safety factors and K values in Table TDM-2 are **minimum** recommended values. Depending on the many factors to consider in selecting and sizing a temporary diversion listed above, higher values for K and S may be appropriate.

Table TDM-2. Temporary Diversion Sizing Coefficients and Safety Factors for Short Duration Projects

Time of Year	Project Duration	Safety Factor, S	Temporary Diversion Sizing Coefficient, K
November - March	Less than 2 weeks	1.0	0.2
November - March	2 weeks to 1 month	1.5	0.2
April - October	Less than 2 weeks (during dry weather conditions)	1.0	0.5
April - October	2 weeks to 1 month	1.5	0.5

Note: K coefficients were developed from regression analysis of baseflow data from USGS Crest Stage Indicator (CSI) data to approximate flows that have a less than 50% chance of being exceeded between November - March.

4. Calculate the recommended temporary diversion design flow rate using equation TDM-1:

$$Q = S K A \quad \text{(Equation TDM-1)}$$

In which,

Q = temporary diversion design flow rate for short-duration projects (cfs).

S = safety factor coefficient from Table TDM-2 based on duration.

K = diversion sizing coefficient from Table TDM-2 based on seasonality.

A = tributary area (square miles).

Of course, if the observed condition at the construction site suggests a higher flow, this should be estimated and used instead.

Example of Short-Duration Temporary Diversion Sizing Methodology

Project Location: Goldsmith Gulch Downstream (north) of E. Cornell Avenue

Planned project will involve approximately 0.12 acres of disturbance for bank stabilization, which will be completed within two weeks during the November to March time period. Using StreamStats, the gross contributing watershed area was determined to be approximately 6.2 mi². Based on project duration and seasonal timing, Table TDM-2 yields S = 1.0, K = 0.2. Equation TDM-1 can be used to calculate the recommended diversion flow:

$$Q = S K A$$

$$Q = 1.0 \bullet 0.2 \bullet 6.2 \text{ mi}^2 = 1.2 \text{ cfs}$$

Had this been a larger restorative maintenance project that will last 4 weeks, but will be started and completed within the November through March period, application of Equation TDM-1 and the recommended safety factor suggest the following diversion design flow:

$$Q = S K A$$

$$Q = 1.5 \bullet 0.2 \bullet 6.2 \text{ mi}^2 = 1.9 \text{ cfs}$$

Sizing Procedure for Interim Duration Projects (longer than one month and up to three months)

When projects last longer than one month but up to three months, a combination of sizing methods should be applied. The recommended temporary diversion flow rate should be evaluated using both the sizing procedure for short duration projects as well as the sizing procedure for long duration projects. These calculated flow rates should be weighed in combination with site-specific factors to determine an appropriate design flow rate. Each site should be evaluated individually to determine factors that may affect the design flow choice. For example, the designer may select to use the more conservative design flow for an interim duration project occurring in July and August where a chance for wet weather is forecast and flooding or damage to the area surrounding the project is unacceptable.

Maintenance and Removal

Because temporary diversions are one of the most critical BMPs for work in waterways, they must be inspected and maintained frequently to remain in effective operating condition. Flow barriers should be inspected at the start and end of each workday and at any time that excess water is noted in dry work areas. For diversion channels, the diversion channel itself should be inspected for signs of erosion, and the lining should be repaired or replaced if there are signs of failure. Check armoring at the diversion return point to the waterway, and add additional armoring if erosion is noted.

Water should not be allowed to flow back through the natural stream until all construction is completed. After redirecting the flow through the natural channel, temporary diversion measures should be removed. For temporary diversion channels, lining materials should be removed, and the diversion channel should then be backfilled and stabilized. Points of tie-in to the natural channel should be protected with riprap sized

in accordance with the *Major Drainage* chapter in Volume 1.

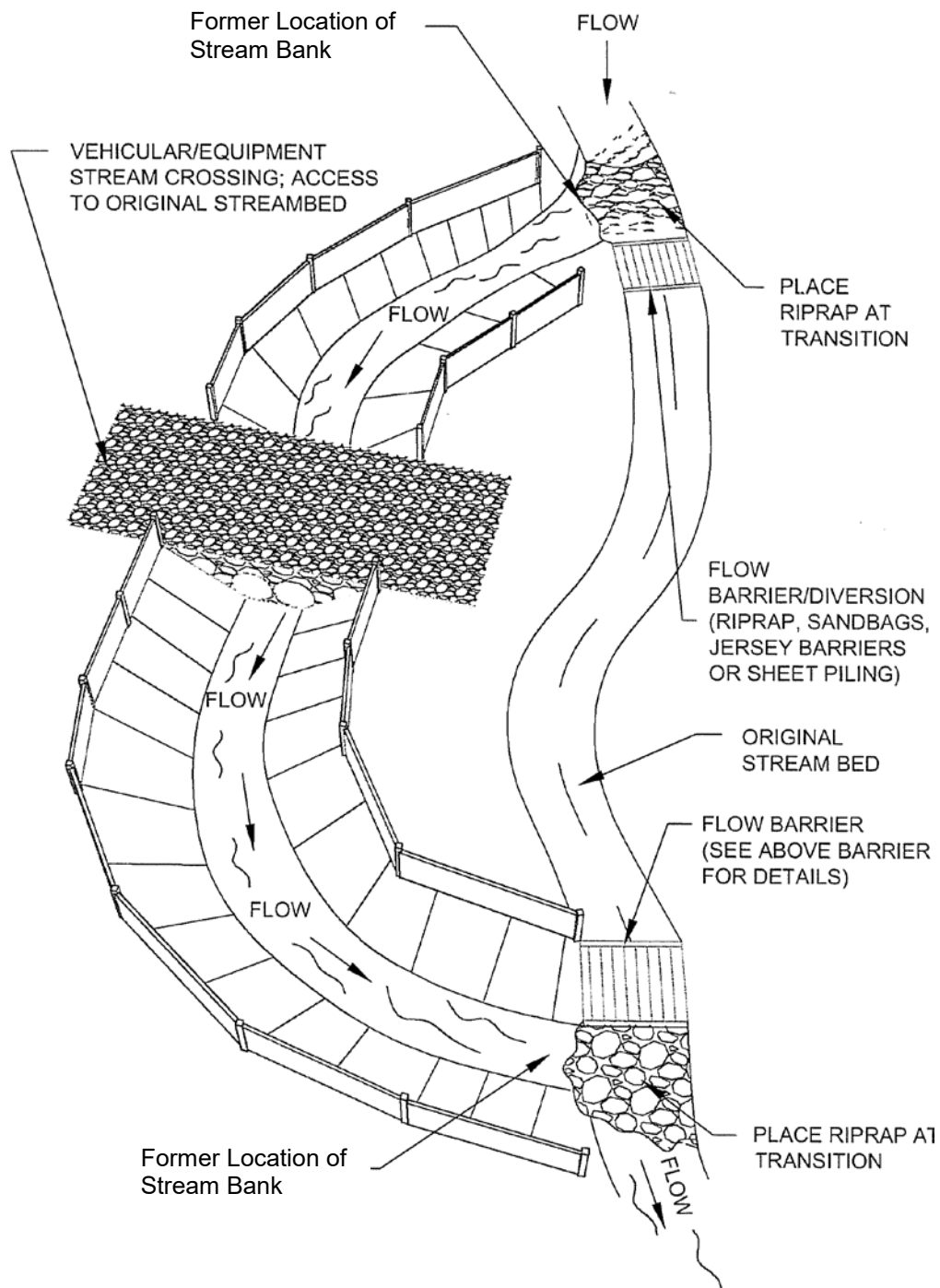


Figure TDM-1. Typical Temporary Diversion Channel

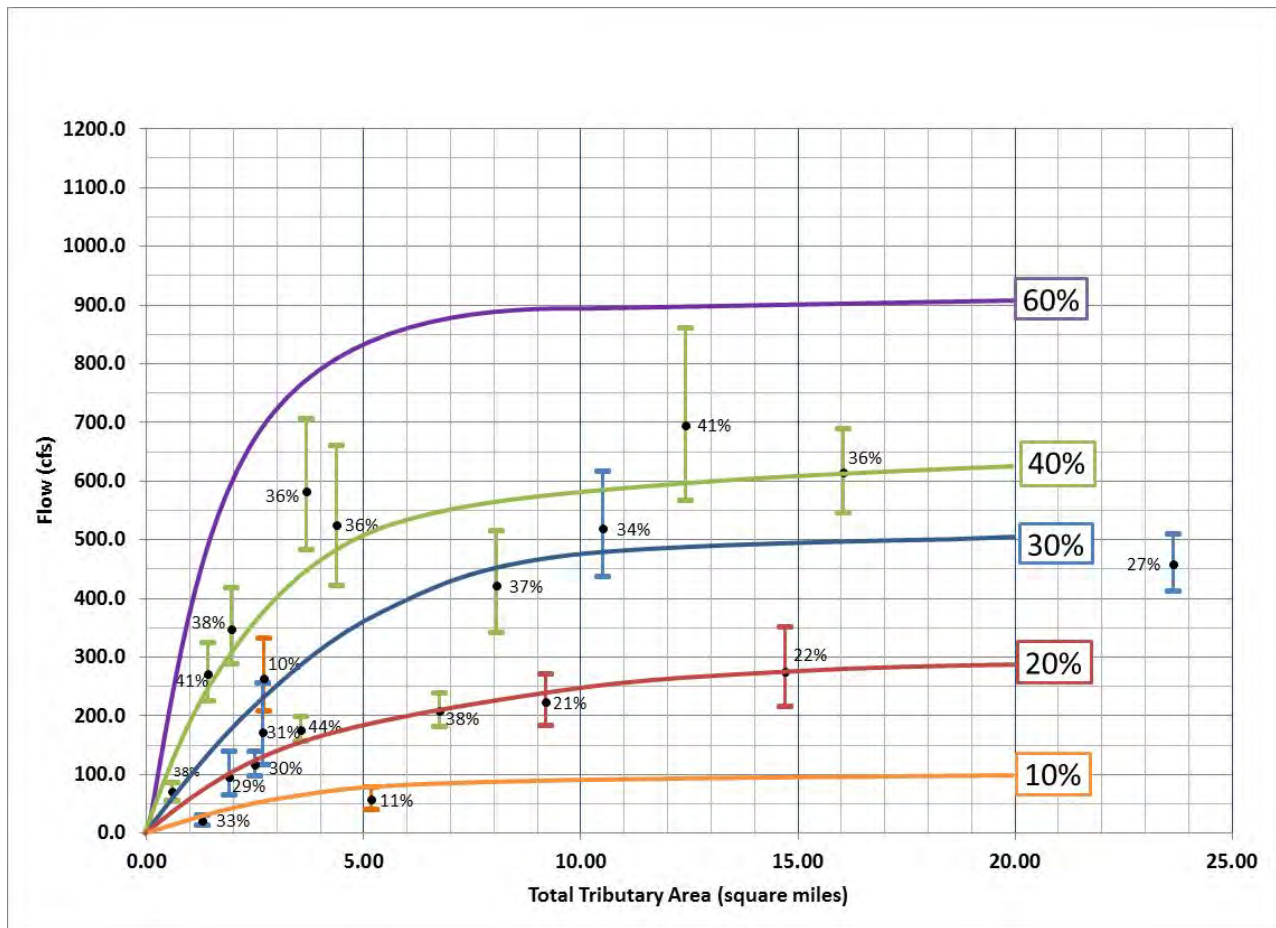
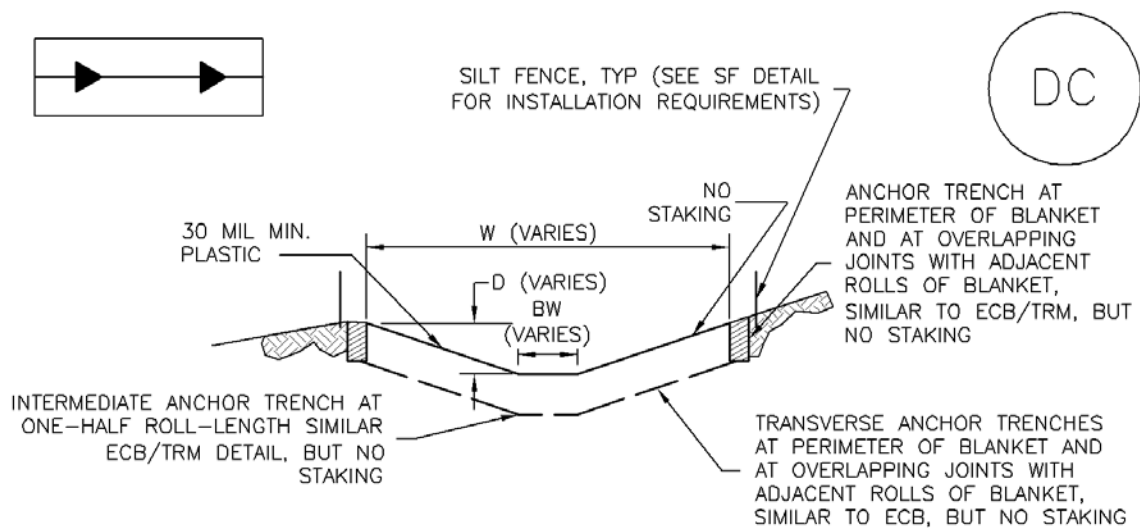
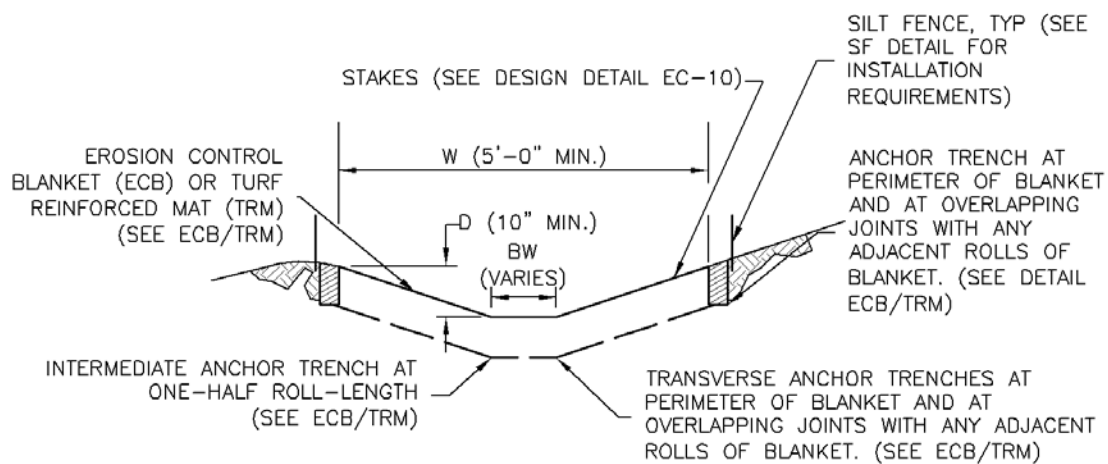


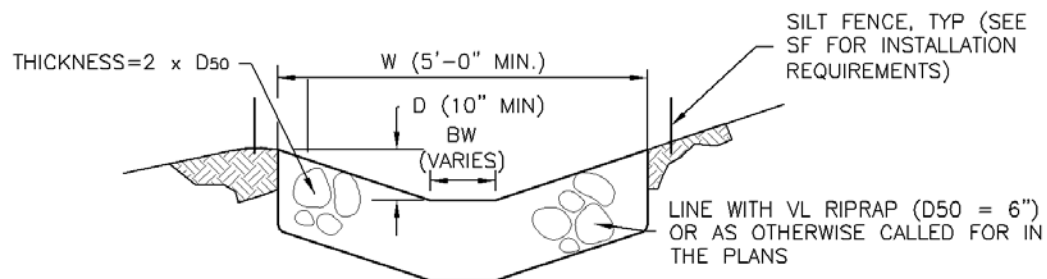
Figure TDM-2. Temporary Diversion Facility Sizing Nomograph for Long Duration Projects (Duration in excess of three months) Based on 2-year Peak Flows - Denver Metropolitan and Adjacent Areas, Updated April 2012



DC-1. PLASTIC LINED DIVERSION CHANNEL



DC-2. GEOTEXTILE OR MAT LINED DIVERSION CHANNEL



DC-3. RIPRAP LINED DIVERSION CHANNEL

CHANNEL DIVERSION INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATION OF DIVERSION CHANNEL
 - TYPE OF CHANNEL (UNLINED, GEOTEXTILE OR MAT LINED, PLASTIC LINE, OR RIPRAP LINED).
 - LENGTH OF EACH TYPE OF CHANNEL.
 - DEPTH, D, WIDTH, W, AND BOTTOM WIDTH, BW.
 - FOR RIPRAP LINED CHANNEL, SIZE OF RIPRAP, D50, SHALL BE SHOWN ON PLANS.
2. SEE DRAINAGE PLANS FOR DETAILS OF PERMANENT CONVEYANCE FACILITIES.
3. DIVERSION CHANNELS INDICATED ON THE SWMP PLAN SHALL BE INSTALLED PRIOR TO WORK IN DOWNGRADIENT AREAS OR NATURAL CHANNELS.
4. FOR GEOTEXTILE OR MAT LINED CHANNELS, INSTALLATION OF GEOTEXTILE OR MAT SHALL CONFORM TO THE REQUIREMENTS OF DETAIL ECB, FOR PLASTIC LINED CHANNELS, INSTALLATION OF ANCHOR TRENCHES SHALL CONFORM TO THE REQUIREMENTS OF DETAIL ECB.
5. WHERE CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION CHANNEL, THE PERMITTEE SHALL INSTALL A TEMPORARY STREAM CROSSING CONFORMING TO THE REQUIREMENTS OF DETAIL TSC.

DIVERSION CHANNEL MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. DIVERSION CHANNELS ARE TO REMAIN IN PLACE UNTIL WORK IN THE DOWNGRADIENT AREA OR NATURAL CHANNEL IS NO LONGER REQUIRED. IF APPROVED BY LOCAL JURISDICTION DIVERSION CHANNEL MAY BE LEFT IN PLACE.
5. IF DIVERSION CHANNELS ARE REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Description

The BMPs selected for construction dewatering vary depending on site-specific features such as soils, topography, anticipated discharge quantities, and discharge location. Dewatering typically involves pumping water from an inundated area to a BMP, and then downstream to a receiving waterway, sediment basin, or well-vegetated area. Dewatering typically involves use of several BMPs in sequence.

Appropriate Uses

Dewatering operations are used when an area of the construction site needs to be dewatered as the result of a large storm event, groundwater, or existing ponding conditions. This can occur during deep excavation, utility trenching, and wetland or pond excavation.

Design and Installation

Dewatering techniques will vary depending on site conditions. However, all dewatering discharges must be treated to remove sediment before discharging from the construction site. Discharging water into a sediment trap or basin is an acceptable treatment option. Water may also be treated using a dewatering filter bag, and a series of straw bales or sediment logs. If these previous options are not feasible due to space or the ability to passively treat the discharge to remove sediment, then a settling tank or an active treatment system may need to be utilized. Settling tanks are manufactured tanks with a series of baffles to promote settling. Flocculants can also be added to the tank to induce more rapid settling. This is an approach sometimes used on highly urbanized construction sites. Contact the state agency for special requirements prior to using flocculents and land application techniques.

Some commonly used methods to handle the pumped water without surface discharge include land application to vegetated areas through a perforated discharge hose (i.e., the "sprinkler method") or dispersal from a water truck for dust control.



Photograph DW-1. A relatively small dewatering operation using straw bales and a dewatering bag.



Photograph DW-2. Dewatering bags used for a relatively large dewatering operation.

Dewatering Operations	
Functions	
Erosion Control	Moderate
Sediment Control	Yes
Site/Material Management	Yes

Dewatering discharges to non-paved areas must minimize the potential for scour at the discharge point either using a velocity dissipation device or dewatering filter bag.

Design Details are provided for these types of dewatering situations:

DW-1. Dewatering for Pond Already Filled with Water

DW-2 Dewatering Sump for Submersed Pump

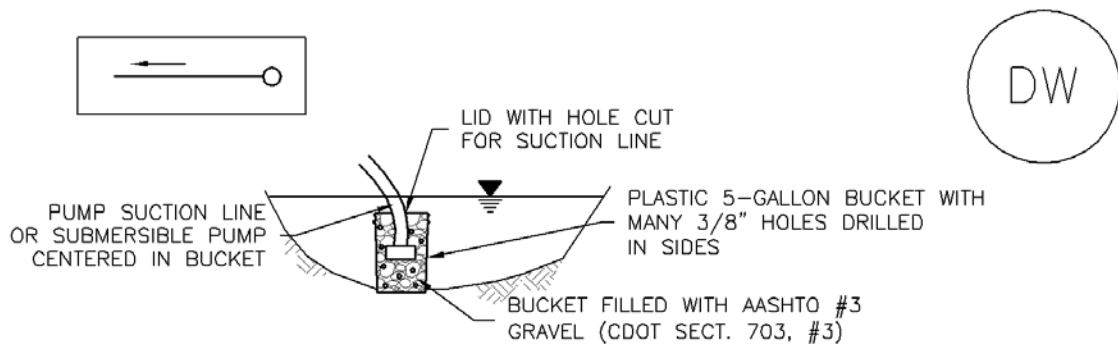
DW-3 Sump Discharge Settling Basin

DW-4 Dewatering Filter Bag

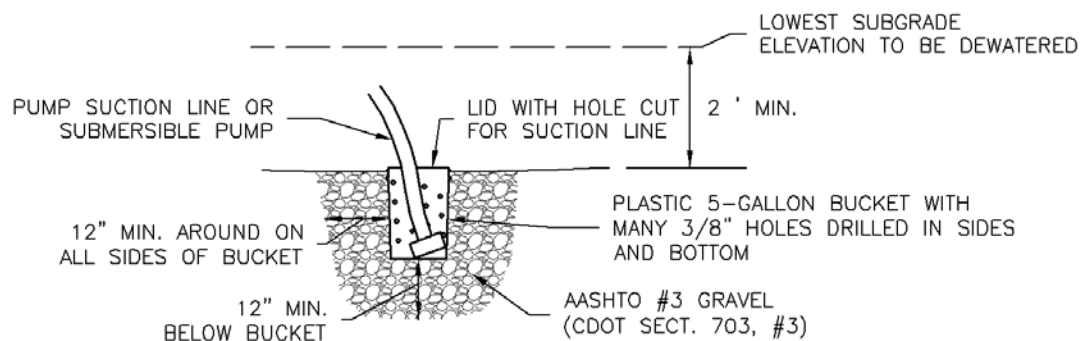
Maintenance and Removal

When a sediment basin or trap is used to enable settling of sediment from construction dewatering discharges, inspect the basin for sediment accumulation. Remove sediment prior to the basin or trap reaching half full. Inspect treatment facilities prior to any dewatering activity. If using a sediment control practice such as a sediment trap or basin, complete all maintenance requirements as described in the fact sheets prior to dewatering.

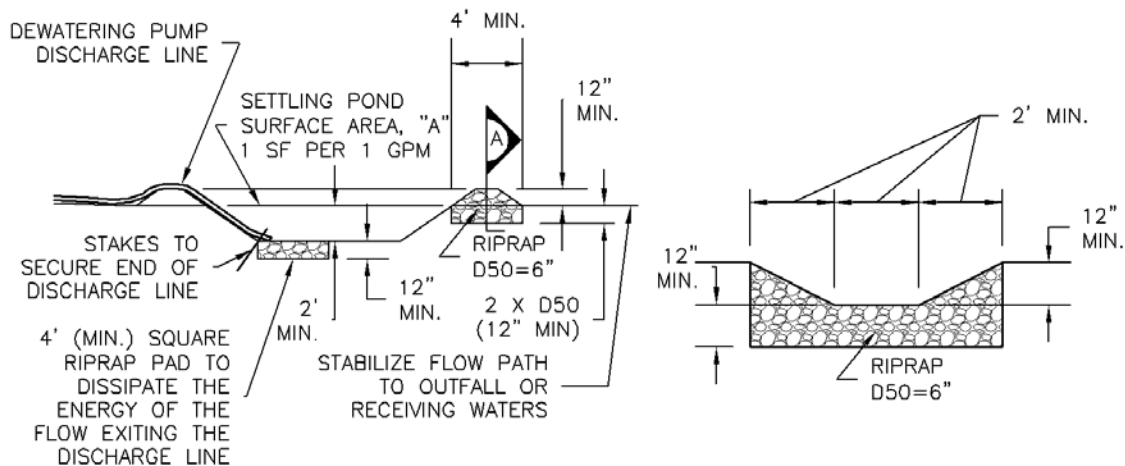
Properly dispose of used dewatering bags, as well as sediment removed from the dewatering BMPs. Depending on the size of the dewatering operation, it may also be necessary to revegetate or otherwise stabilize the area where the dewatering operation was occurring.



DW-1. DEWATERING POND ALREADY FILLED WITH WATER

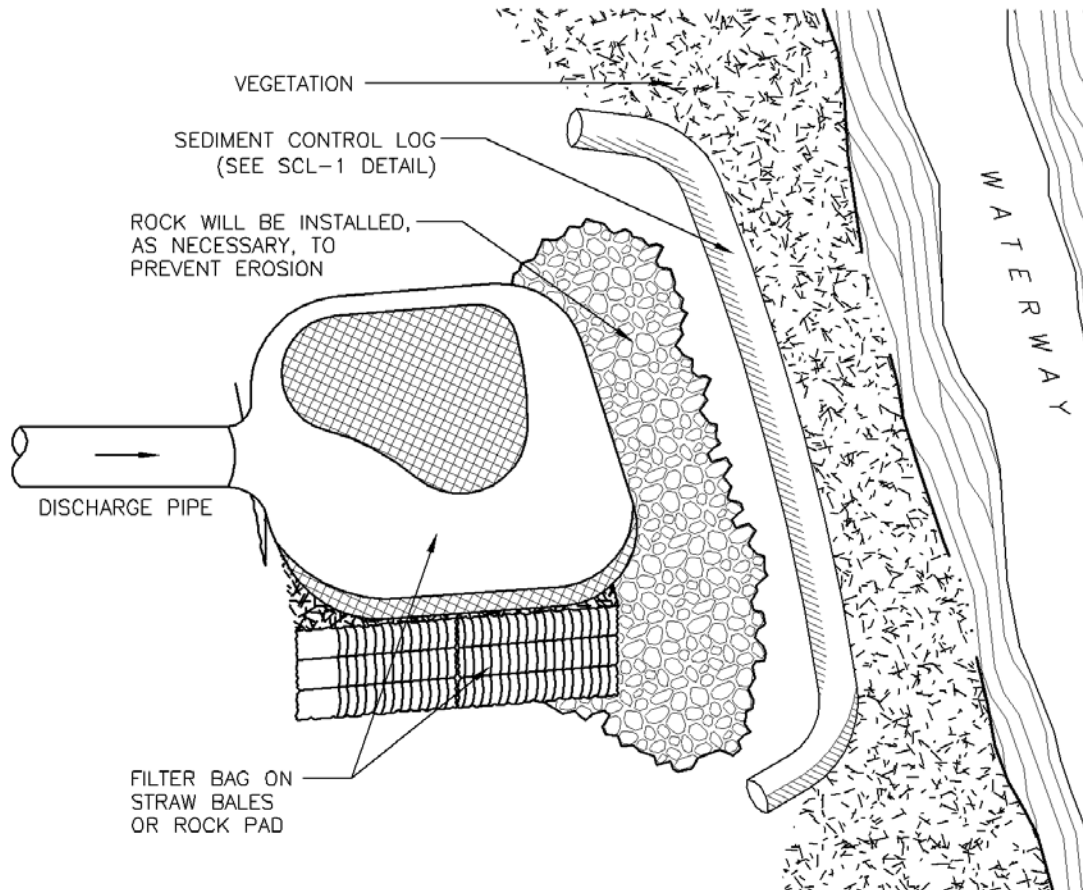


DW-2. DEWATERING SUMP FOR SUBMERSED PUMP



DW-3. SUMP DISCHARGE
SETTLING BASIN

SETTLING BASIN
SECTION A



DW-4. DEWATERING FILTER BAG

DEWATERING INSTALLATION NOTES

1. SEE PLAN VIEW FOR;
 - LOCATION OF DEWATERING EQUIPMENT.
 - TYPE OF DEWATERING OPERATION (DW-1 TO DW-4).
2. THE OWNER OR CONTRACTOR SHALL OBTAIN A CONSTRUCTION DISCHARGE (DEWATERING) PERMIT FROM THE STATE PRIOR TO ANY DEWATERING OPERATIONS DISCHARGING FROM THE SITE. ALL DEWATERING SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE PERMIT.
3. THE OWNER OR OPERATOR SHALL PROVIDE, OPERATE, AND MAINTAIN DEWATERING SYSTEMS OF SUFFICIENT SIZE AND CAPACITY TO PERMIT EXCAVATION AND SUBSEQUENT CONSTRUCTION IN DRY CONDITIONS AND TO LOWER AND MAINTAIN THE GROUNDWATER LEVEL A MINIMUM OF 2- FEET BELOW THE LOWEST POINT OF EXCAVATION AND CONTINUOUSLY MAINTAIN EXCAVATIONS FREE OF WATER UNTIL BACK-FILLED TO FINAL GRADE.

DEWATERING INSTALLATION NOTES

4. DEWATERING OPERATIONS SHALL USE ONE OR MORE OF THE DEWATERING SUMPS SHOWN ABOVE, WELL POINTS, OR OTHER MEANS APPROVED BY THE LOCAL JURISDICTION TO REDUCE THE PUMPING OF SEDIMENT, AND SHALL PROVIDE A TEMPORARY SEDIMENT BASIN OR FILTRATION BMP TO REDUCE SEDIMENT TO ALLOWABLE LEVELS PRIOR TO RELEASE OFF SITE OR TO A RECEIVING WATER. A SEDIMENT BASIN MAY BE USED IN LIEU OF SUMP DISCHARGE SETTLING BASIN SHOWN ABOVE IF A 4-FOOT-SQUARE RIPRAP PAD IS PLACED AT THE DISCHARGE POINT AND THE DISCHARGE END OF THE LINE IS STAKED IN PLACE TO PREVENT MOVEMENT OF THE LINE.

DEWATERING MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. DEWATERING BMPs ARE REQUIRED IN ADDITION TO ALL OTHER PERMIT REQUIREMENTS.

5. TEMPORARY SETTLING BASINS SHALL BE REMOVED WHEN NO LONGER NEEDED FOR DEWATERING OPERATIONS. ANY DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

Description

Where an actively flowing watercourse must be crossed regularly by construction vehicles, a temporary crossing should be provided. Three primary methods are available:

- Culvert crossing
- Stream ford
- Temporary bridge

Culvert crossings and fords are the most commonly used methods. Due to the expense associated with a temporary bridge, these are used primarily on long-term projects.



Photograph TSC-1. A temporary stream crossing using culverts.
Photo courtesy of Tom Gore.

Appropriate Uses

Construction vehicles shall be kept out of waterways to the maximum extent practicable. Use a temporary stream crossing when it is absolutely necessary to cross a stream on a construction site. Construct a temporary crossing even if the stream or drainageway is typically dry. Multiple stream crossings should be avoided to minimize environmental impacts.

A permit is required for placement of fill in a waterway under Section 404 of the Clean Water Act. The local office of the U.S. Army Corps of Engineers (USACE) should be contacted concerning the requirements for obtaining a 404 permit. In addition, a permit from the U.S. Fish and Wildlife Service (USFWS) may be needed if endangered species are of concern in the work area. Typically, the USFWS issues are addressed by a 404 permit, if one is required. The municipality of jurisdiction should also be consulted, and can provide assistance. Other permits to be obtained may include a floodplain development permit from the local jurisdiction.

Design and Installation

Design details are provided for these types of stream crossings:

TSC-1. Culvert Crossing

TSC-2. Ford Crossing

TSC-3. Flume Crossing

Temporary Stream Crossing	
Functions	
Erosion Control	Yes
Sediment Control	Yes
Site/Material Management	No

A culvert crossing should be sized appropriately with consideration for the duration of construction and seasonal variation of flows. The sizing methodology provided in the Temporary Diversion Methods Fact Sheet is also appropriate for determining the design flow for temporary stream crossings. Culvert sizing must account for the headwater and tailwater controls to properly size the culvert. For additional discussion on design of box culverts and pipes, see the *Major Drainage* chapter in Volume 1. The designer also needs to confirm that the riprap selected is appropriate for the conditions in the channel being crossed.

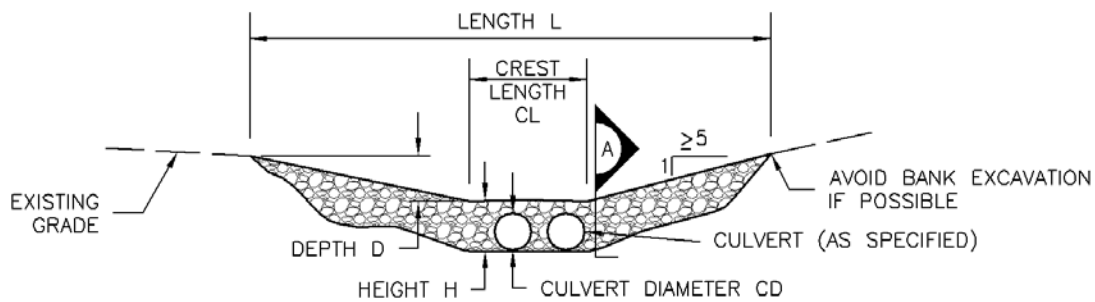
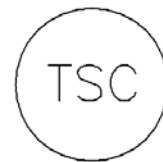
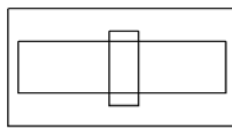
When a ford must be used, namely when a culvert is not practical or the best solution, the ford should be lined with at least a 12-inch thick layer of Type VL ($D_{50} = 6$ inches) or Type L ($D_{50} = 9$ inches) riprap with void spaces filled with 1-1/2 inch diameter rock. Ford crossings are recommended primarily for crossings of ephemeral (i.e. intermittently, briefly flowing) streams.

For a temporary bridge crossing, consult with a structural and/or geotechnical engineer for temporary bridge design or consider pre-fabricated alternatives.

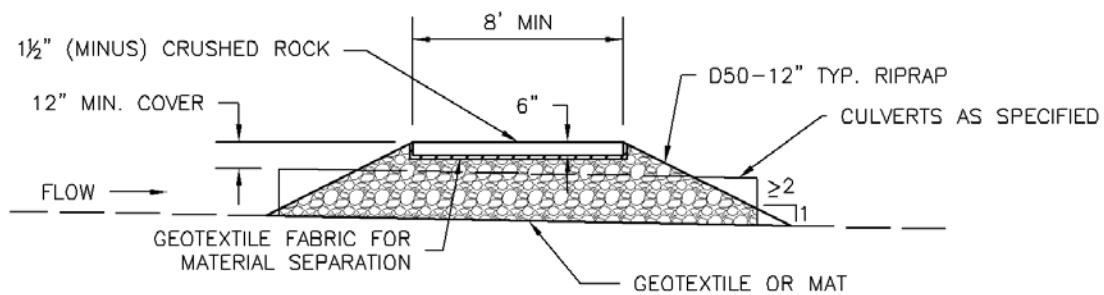
Maintenance and Removal

Inspect stream for bank erosion and in-stream degradation. If bank erosion is occurring, stabilize banks using erosion control practices such as erosion control blankets. If in-stream degradation is occurring, armor the culvert outlet(s) with riprap to dissipate energy. If sediment is accumulating upstream of the crossing, remove excess sediment as needed to maintain the functionality of the crossing.

Remove the temporary crossing when it is no longer needed for construction. Take care to minimize the amount of sediment lost into the stream upon removal. Once the crossing has been removed, stabilize the stream banks with seed and erosion control blankets.



CULVERT CROSSING SECTION

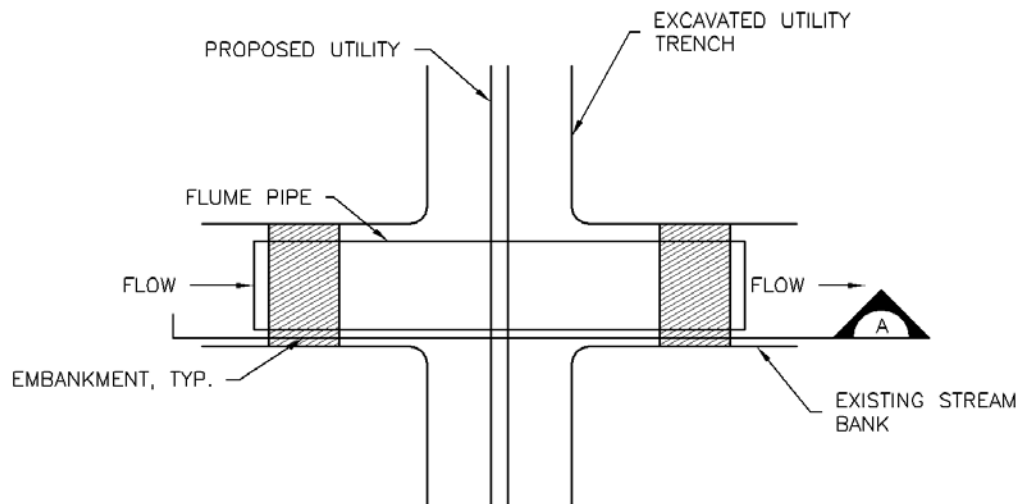
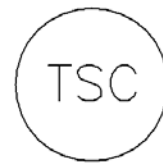


SECTION A

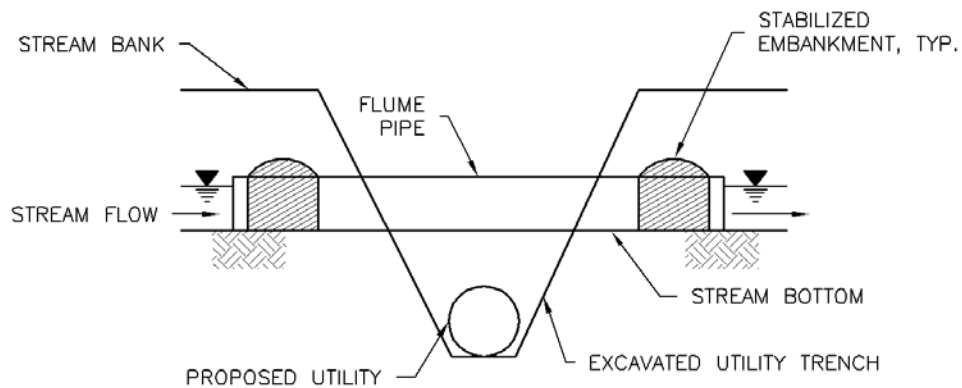
TSC-1. CULVERT CROSSING



TSC-2. FORD CROSSING



FLUME CROSSING PLAN



SECTION A

TSC-3. FLUME CROSSING

TEMPORARY STREAM CROSSING INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
 - LOCATIONS OF TEMPORARY STREAM CROSSINGS.
 - STREAM CROSSING TYPE (FORD, CULVERT, OR FLUME).
 - FOR FORD CROSSING: LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).
 - FOR CULVERT CROSSING: LENGTH (L), CREST LENGTH (CL), CROSSING HEIGHT (H), DEPTH (D), CULVERT DIAMETER (CD), AND NUMBER, TYPE AND CLASS OR GAUGE OF CULVERTS.
2. TEMPORARY STREAM CROSSING DIMENSIONS, D50, AND NUMBER OF CULVERTS INDICATED (FOR CULVERT CROSSING) SHALL BE CONSIDERED MINIMUM DIMENSIONS; ENGINEER MAY ELECT TO INSTALL LARGER FACILITIES. ANY DAMAGE TO STREAM CROSSING OR EXISTING STREAM CHANNEL DURING BASEFLOW OR FLOOD EVENTS SHALL BE PROMPTLY REPAIRED.
3. SEE MAJOR DRAINAGE CHAPTER FOR RIPRAP GRADATIONS.
4. WHERE FAILURE OF A STREAM CROSSING CAN RESULT IN SIGNIFICANT DAMAGE OR HARM IT MUST BE DESIGNED BY A STRUCTURAL ENGINEER.

TEMPORARY STREAM CROSSING MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. REMOVE SEDIMENT ACCUMULATED UPSTREAM OF CROSSING AS NEEDED TO MAINTAIN THE FUNCTIONALITY OF THE CROSSING.
5. STREAM CROSSINGS ARE TO REMAIN IN PLACE UNTIL NO LONGER NEEDED AND SHALL BE REMOVED PRIOR TO THE END OF CONSTRUCTION.
6. WHEN STREAM CROSSINGS ARE REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED AND COVERED WITH GEOTEXTILE OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND CITY OF AURORA, COLORADO (Va. DSWC), NOT AVAILABLE IN AUTOCAD)

Description

Temporary batch plant management includes implementing multiple BMPs such as perimeter controls, concrete washout area, stabilized construction access, good housekeeping, and other practices designed to reduce polluted runoff from the batch plant area.

Appropriate Uses

Implement this BMP at temporary batch plants and identify the location of the batch plant in the SWMP.

Additional permitting may be required for the operation of batch plants depending on their duration and location.



Photograph TBP-1. Effective stormwater management at temporary batch plants requires implementation of multiple BMPs. Photo courtesy of California Stormwater BMP Handbook.

Design and Installation

The following lists temporary management strategies to mitigate runoff from batch plant operations:

- When stockpiling materials, follow the Stockpile Management BMP.
- Locate batch plants away from storm drains and natural surface waters.
- A perimeter control should be installed around the temporary batch plant.
- Install run-on controls where feasible.
- A designated concrete washout should be located within the perimeter of the site following the procedures in the Concrete Washout Area BMP.
- Follow the Good Housekeeping BMP, including proper spill containment measures, materials storage, and waste storage practices.
- A stabilized construction entrance or vehicle tracking control pad should be installed at the plant entrance, in accordance with the Vehicle Tracking Control BMP.

Maintenance and Removal

Inspect the batch plant for proper functioning of the BMPs, with attention to material and waste storage areas, integrity of perimeter BMPs, and an effective stabilized construction entrance.

Temporary Batch Plants	
Functions	
Erosion Control	No
Sediment Control	No
Site/Material Management	Yes

After the temporary batch plant is no longer needed, remove stockpiled materials and equipment, regrade the site as needed, and revegetate or otherwise stabilize the area.

Description

Manage runoff from paving and grinding operations to reduce pollutants entering storm drainage systems and natural drainageways.

Appropriate Uses

Use runoff management practices during all paving and grinding operations such as surfacing, resurfacing, and saw cutting.



Photograph PGO-1. Paving operations on a Colorado highway. Photo courtesy of CDOT.

Design and Installation

There are a variety of management strategies that can be used to manage runoff from paving and grinding operations:

- Establish inlet protection for all inlets that could potentially receive runoff.
- Schedule paving operations when dry weather is forecasted.
- Keep spill kits onsite for equipment spills and keep drip pans onsite for stored equipment.
- Install perimeter controls when asphalt material is used on embankments or shoulders near waterways, drainages, or inlets.
- Do not wash any paved surface into receiving storm drain inlets or natural drainageways. Instead, loose material should be swept or vacuumed following paving and grinding operations.
- Store materials away from drainages or waterways.
- Recycle asphalt and pavement material when feasible. Material that cannot be recycled must be disposed of in accordance with applicable regulations.

See BMP Fact Sheets for Inlet Protection, Silt Fence and other perimeter controls selected for use during paving and grinding operations.

Maintenance and Removal

Perform maintenance and removal of inlet protection and perimeter controls in accordance with their respective fact sheets.

Promptly respond to spills in accordance with the spill prevention and control plan.

Paving and Grinding Operations	
Functions	
Erosion Control	No
Sediment Control	No
Site/Material Management	Yes

Retaining Wall (RW)

SM-13



Description

Retaining walls are structures that are used to stabilize and hold soil in place, gain space on roadways or well pads, or to keep soil contained within a site boundary. This BMP will cover retaining walls constructed with rock, boulders or gabions. Gabions are rectangular, rock-filled wire baskets that are pervious, semi-flexible building blocks which can be used to armor the bed and/or banks of channels or to divert flow away from eroding channel sections.

Several different retaining wall types are:

1. **Rigid Gravity and Semi-Gravity Walls.** These walls may be constructed of concrete or stone masonry. The rigid gravity and semi-gravity walls develop their capacity from their dead weights and structural resistance, and are generally used for permanent applications.
2. **Non-gravity Cantilevered Walls.** These walls develop lateral resistance through the embedment of vertical wall elements and support retained soil with wall facing elements. Vertical wall elements are normally extended deep in the ground to provide lateral and vertical support. The vertical wall elements can be piles, drilled shafts, steel sheet piles, etc. Wall faces can be reinforced concrete, metal, or timber. Cantilevered walls are generally limited to a maximum height of about 15 feet.
3. **Anchored Walls.** These walls typically consist of the same elements as the non-gravity cantilevered walls but derive additional lateral resistance from one or more tiers of anchors. The anchored walls are typically used in the cut situation, in which the construction proceeds from the top to the base of the wall.

Applicability

Retaining walls should be used when sites have very steep slopes or loose, highly erodible soils that cause other methods, such as vegetative stabilization or regrading, to be ineffective. The preconstruction drainage pattern should be maintained to the extent possible. Retaining walls may be used for the following applications:

- Near the toe of a cut or fill slope to mechanically stabilize steep slopes and so that a flatter slope can be constructed to prevent or minimize slope erosion or failure. Particularly useful along access road cut slopes.
- Along a stream bank or drainage channel, to keep a toe of a slope from encroaching into a stream and thus prevent potential undercutting of the toe by flowing water.
- As headwalls at culvert inlets and outlets to prevent scour and undercutting.

Limitations

- Some retaining walls are a structural element that must be professionally designed.
- To be effective, retaining walls must be designed to handle expected loads. Non-engineered walls should not be used where traffic is expected near the top of the wall.
- Retaining walls must be properly installed and maintained to avoid failure.
- Some types of retaining walls must be placed on a good foundation, such as bedrock or firm, in-place soil.
- Some walls have height restrictions and backfill may be required to meet specific material property requirements.
- Materials costs and professional design requirements may make use of gabions impractical.
- When used in channels with high sediment loads, the galvanizing wire on gabion cages quickly wears off, causing rusting and the premature failure of the cages.

Design Criteria

Most retaining walls require a site-specific design. Wall heights, requirements for drainage, and suitable materials must be determined through on-site investigation. An engineered retaining structure is a designed structure that is supported by plans and specifications signed and sealed by a Professional Engineer. Non-engineered

retaining structures may be designed by an engineer; however, if the design is not supported by the seal and signature, the retaining structure is not considered engineered.

Gabions

Gabions should be designed and installed in accordance with manufacturer's standards and specifications and must be able to handle expected storm and flood conditions. At a minimum, they should be constructed of a hexagonal triple twist mesh of heavily galvanized steel wire (galvanized wire may also receive a polyvinyl chloride coating). The maximum linear dimension of the mesh opening shall not exceed 4 ½ inches and the area of the mesh opening shall not exceed 10 square inches.

The design water velocity for channels utilizing gabions should not exceed those listed as follows:

Gabion Thickness (feet)	Maximum Velocity (feet per second)
0.5	6
0.75	11
1.0	14

Construction Specifications

Rock Retaining Wall Guidelines

See Figure RW-1.

1. Excavate a footing trench at the location of the proposed wall.
2. Place the largest rocks in the footing trench with their longitudinal axis normal to the wall face. Arrange subsequent rock layers so that each rock above the foundation course has a firm seating on the underlying rocks.
3. The batter of the wall face shall be between ½H:1V and vertical, depending upon the height of the wall, the height of the slope, the width of the right-of-way, or other limitations on space.
4. Place fill material behind the rock wall. Slope above the wall should be maintained at 2H:1V or flatter. Backfill the footing trench with excavated material. If a roadway is located at the toe of the wall, pave the roadway up to the base of the rock wall and provide roadway curb for water transport. If a roadway is not located at the toe of the retaining wall, slope the backfilled material away from the wall.
5. Revegetate the stabilized slope with a method applicable to the particular site.

Gabion Retaining Wall Guidelines

See Figure RW-2. Gabions shall be fabricated in such a manner that the sides, ends, and lid can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single unit construction and shall be installed according manufacturer's recommendations. General specifications are listed below.

1. Clear and grade the area of trees, brush, vegetation and unsuitable soils. Compact subgrade firmly to prevent slumping or undercutting.
2. Install a filter fabric or granular filter according to RIPRAP (R) to maintain separation of rock material with the underlying soil, if required.
3. Place empty gabion baskets. Each row, tier, or layer of baskets should be reasonably straight and should conform to the specified line and grade (see Figure RW-2 for details). The empty gabion baskets should be fastened to the adjacent baskets along the top and vertical edges. Each layer should be fastened to the underlying layer along the front, back and ends. Fastening should be performed in the same manner as provided for assembling the gabion units.
4. Unless otherwise indicated on the plans, the vertical joints between basket units of adjacent tiers or layers, along the length of the structure, should be staggered by at least one cell.
5. Before filling each gabion with rock, all kinks and folds in the wire mesh should be removed and all baskets should be properly aligned. A standard fence stretcher, chain fall or steel rod may be used to stretch the wire baskets and hold alignment.
6. The gabion cells should be carefully filled with four to eight inch rock placed by hand/machine in such a manner that the alignment of the structure will be maintained and so as to avoid bulges and to minimize voids. Rock should be sound, durable, and well graded. All exposed rock surface should have a reasonably smooth and neat appearance. No sharp rock edges should project through the wire mesh.
7. The gabion cells in any row or layer should be filled in stages so that local deformations may be avoided.
8. At no time should any cell be filled to a depth exceeding 12 inches more than any adjacent cell.
9. The layer of rock should completely fill the gabion basket so that the lid will bear on the rock when it is secured. The lid should be joined to the sides, ends, and diaphragms in the same manner as specified for joining the vertical edges. The gabion basket lid should be secured so that no more than one inch gap remains at any connection.

10. Gabion rows or layers not completed at the end of each shift should have the last gabion filled with rock tied internally as an end gabion.
11. The area behind the gabion structure should be backfilled with granular material. Geotextile, if required, should be spread uniformly over the back of the gabion structure. Joining edges of the geotextile should be overlapped a minimum of 12 inches and should be anchored in position with approved anchoring devices. The Contractor should place the backfill material in a manner that will not tear, puncture, or shift the geotextile.

All other retaining walls should be constructed as designed by a Professional Engineer.

Maintenance Considerations

The frequency of inspections should be in accordance with the Storm Water Management Plan (SWMP). Check for structural failure, erosion, damage, instability or other signs of deterioration. In stream bank installations and culvert inlets and outlets also inspect for signs of undercutting. Check wire of gabion cages for rusting and wear. Repair or replace any damaged areas immediately to restore designed effectiveness and to prevent damage or erosion of the slope or stream bank.

References

City of Knoxville, Stormwater Engineering, *Knoxville BMP Manual - Best Management Practices*. July 2003.

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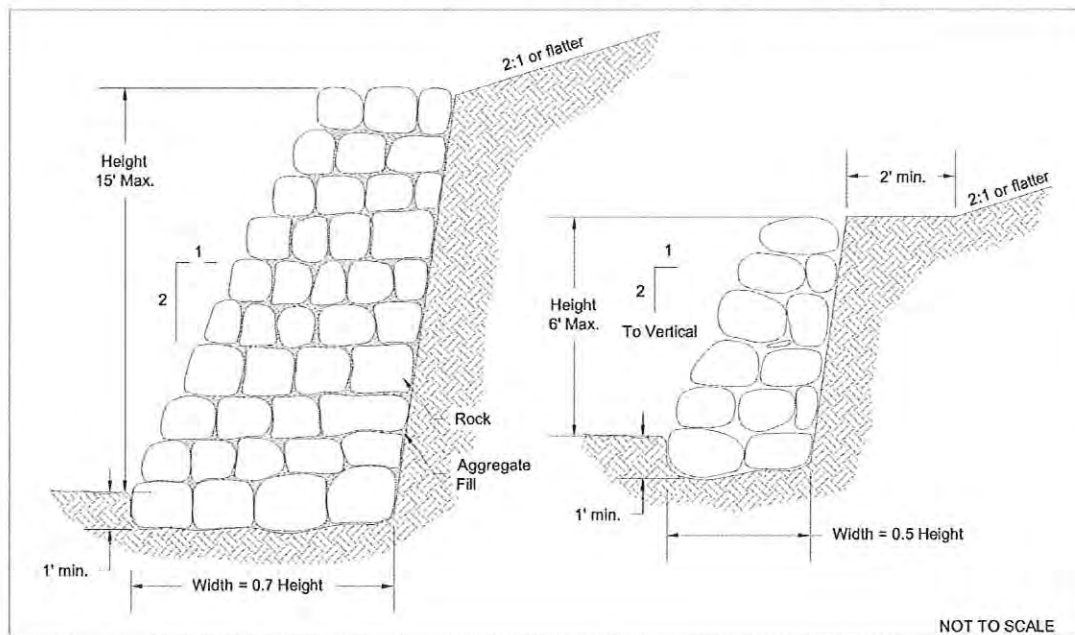
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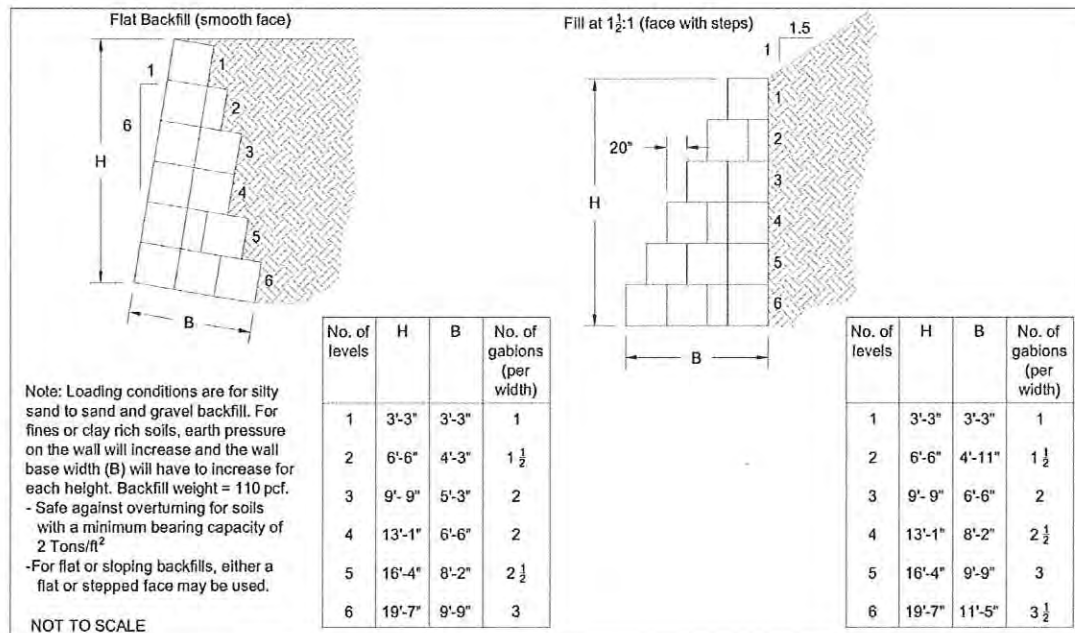
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New York State Department of Environmental Conservation, *New York Guidelines for Urban Erosion and Sediment Control*. New York. Fourth Edition, 1997. <<http://www.dec.state.ny.us/website/dow/toolbox/escstandards>>

**Figure RW-1
Construction of Rock Retaining Structures**



**Figure RW-2
Gabion Design**



Appendix E

Environmental Spill Reporting Brochure

COGCC Revised Rule 906

SPCC Plan Narrative

involving a radioactive or infectious material, or there is a release of a marine pollutant.

Spills and incidents that have or may result in a spill along a highway must be reported to the nearest law enforcement agency immediately. The Colorado State Patrol and CDPHE must also be notified as soon as possible. In the event of a spill of hazardous waste at a transfer facility, the transporter must notify CDPHE within 24 hours if the spill exceeds 55 gallons or if there is a fire or explosion.

The National Response Center should be notified as soon as possible after discovery of a release of a hazardous liquid or carbon dioxide from a pipeline system if a person is killed or injured, there is a fire or explosion, there is property damage of \$50,000 or more, or any nearby water body is contaminated.

The National Response Center and the Colorado Public Utilities Commission Gas Pipeline Safety Section must be notified as soon as possible, but not more than two hours after discovery of a release of gas from a natural gas pipeline or liquefied natural gas facility if a person is killed or injured, there is an emergency shutdown of the facility, or there is property damage of \$50,000 or more. The Colorado Public Utilities Commission should also be notified if there is a gas leak from a pipeline, liquefied natural gas system, master meter system or a propane system that results in the evacuation of 50 or more people from an occupied building or the closure of a roadway.

Oil and Gas Exploration

All Class I major events on federal lands, including releases of hazardous substances in excess of the CERCLA reportable quantity and spills of more than 100 barrels of fluid and/or 500 MCF of gas released, must be reported to the Bureau of Land Management (BLM) immediately. Spills of oil, gas, salt water, toxic liquids and waste materials must also be reported to the BLM and the surface management agency.

Spills of exploration and production (E&P) waste on state or private lands in excess of 20 barrels, and spills of any size that impact or threaten to impact waters of the state, an occupied structure, or public byway must be reported to the Colorado Oil and Gas Conservation Commission as soon as practicable, but not more than 24 hours after discovery. Spills of any

size that impact or threaten to impact waters of the state must be reported to CDPHE immediately. Spills that impact or threaten to impact a surface water intake must be reported to the emergency contact for that facility immediately after discovery. Spills of more than five (5) barrels of E&P waste must be reported in writing to the Oil and Gas Conservation Commission within 10 days of discovery.

REPORTING NUMBERS

National Response Center (24-hour)
1-800-424-8802

CDPHE Colorado Environmental Release and Incident Reporting Line (24-hour)
1-877-518-5608

Radiation Incident Reporting Line (24-hour)
303-877-9757

Colorado State Patrol (24-hour)
303-239-4501

Division of Oil and Public Safety
(business hours)
303-318-8547

Oil and Gas Conservation Commission
(business hours)
303-894-2100

Colorado Public Utilities Commission Gas Pipeline Safety Section (business hours)
303-894-2851

Local Emergency Planning Committees
(to obtain list, business hours)
720-852-6603



**Colorado Department
of Public Health
and Environment**

Environmental Spill Reporting

Colorado Department of Public
Health and Environment
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<http://www.cdphe.state.co.us>

January 2009

When a release of a hazardous material or other substance occurs to the environment, there are a number of reporting and notification requirements that must be followed by the company or individual responsible for the release. Most spills are covered by more than one reporting requirement, and **all** requirements must be met. In addition to verbal notification, written reports are generally required. This brochure briefly explains the major requirements. A more detailed description is provided in the "Reporting Environmental Releases in Colorado" Guidance Document, available on the web.

Releases that must be reported to the Colorado Department of Public Health and Environment (CDPHE) may be reported to the Colorado Environmental Release and Incident Reporting Line.

ENVIRONMENTAL SPILL REPORTING

CERCLA, EPCRA and RCRA

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA) require that a release of a reportable quantity or more of a hazardous substance to the environment be reported immediately to the appropriate authorities when the release is discovered.

Under CERCLA, reportable quantities were established for hazardous substances listed or designated under other environmental statutes. These include:

- all hazardous air pollutants (HAPs) listed under Section 112(b) of the Clean Air Act.
- all toxic pollutants designated under Section 307(a) or Section 311(b)(2)(A) of the Clean Water Act.
- all Resource Conservation and Recovery Act (RCRA) characteristic and listed hazardous wastes.
- any element, compound, or substance designated under Section 102 of CERCLA.

EPCRA established a list of extremely hazardous substances (EHS) that could cause serious irreversible health effects from accidental releases. Many substances appear on both the CERCLA and EPCRA lists. EPCRA extremely hazardous substances that are also CERCLA hazardous substances have the same reportable quantity (RQ) as under CERCLA. EPCRA extremely hazardous substances that are not listed under CERCLA have a reportable quantity that is equal to their threshold planning quantity (TPQ). A list of CERCLA reportable quantities is included in 40 CFR Section 302.4. A list of EPCRA threshold planning quantities is included in 40 CFR Part 355 Appendices A & B.

CERCLA-reportable releases must be reported immediately to the National Response Center (NRC), while EPCRA-reportable releases must be reported immediately to the National Response Center, the State Emergency Response Commission (SERC) and the affected Local Emergency Planning Committee (LEPC). If the release is an EPCRA extremely

hazardous substance, but not a CERCLA hazardous substance, and there is absolutely no potential to affect off-site persons, then only the State Emergency Planning Commission (represented by CDPHE for reporting purposes) and the Local Emergency Planning Committee need to be notified.

In the case of a release of hazardous waste stored in tanks, RCRA-permitted facilities and large quantity generators must also notify CDPHE within 24 hours of any release to the environment that is greater than one (1) pound.

Radiation Control

Each licensee or registrant must report to the Radiation Incident Reporting Line in the event of lost, stolen or missing licensed or registered radioactive materials or radiation machines, releases of radioactive materials, contamination events, and fires or explosions involving radioactive materials. Releases of radionuclides are reportable under CERCLA.

Clean Water Act

The Clean Water Act requires the person in charge of a facility or vessel to immediately report to the National Response Center all discharges of oil or designated hazardous substances to water. Oil means oil of any kind or form. Designated hazardous substances are included in the CERCLA list.

The Clean Water Act also requires that facilities with a National Pollutant Discharge Elimination System (NPDES) permit report to the National Response Center within 24 hours of becoming aware of any unanticipated bypasses or upsets that cause an exceedance of the effluent limits in their permit and any violations of their maximum daily discharge limits for pollutants listed in their permit.

A release of any chemical, oil, petroleum product, sewage, etc., which may enter waters of the state of Colorado (which include surface water, ground water and dry gullies and storm sewers leading to surface water) must be reported immediately to CDPHE. Any accidental discharge to the sanitary sewer system must be reported immediately to the local sewer authority and the affected wastewater treatment plant. For additional regarding releases to water, please see "Guidance for Reporting Spills under the Colorado

Water Quality Control Act and Colorado Discharge Permits" at <http://www.cdphe.state.co.us/op/wqcc/Resources/Guidance/spillguidance.pdf>.

Clean Air Act

Hazardous air pollutants (HAPs) are designated as hazardous substances under CERCLA. If a facility has an air permit but the permit does not allow for or does not specify the release of a substance, or if the facility does not have an air permit, then all releases in excess of the CERCLA / EPCRA reportable quantity for that substance must be reported to the National Response Center and CDPHE. If the facility releases more of a substance than is allowed under its air permit, the facility must also report the release. Discharges of a substance that are within the allowable limits specified in the facility's permit do not need to be reported.

Regulated Storage Tanks

Owners and operators of regulated storage tank systems must report a release or suspected release of regulated substances to the Division of Oil and Public Safety at the Colorado Department of Labor and Employment within 24 hours. Under this program, the reportable quantity for petroleum releases is 25 gallons or more, or any amount that causes a sheen on nearby surface water. Spills of less than 25 gallons of petroleum must be immediately contained and cleaned up. If cleanup cannot be accomplished within 24 hours, the Division of Oil and Public Safety must be notified immediately.

Spills of hazardous substances from tanks in excess of the CERCLA or EPCRA reportable quantity must be reported immediately to the National Response Center, CDPHE and the local fire authority, and to the Division of Oil and Public Safety within 24 hours.

Transportation and Pipelines

The person in physical possession of a hazardous material must notify the National Response Center as soon as practical, but not to exceed 12 hours after the incident, if as a direct result of the hazardous material, a person is killed or injured, there is an evacuation of the general public lasting more than an hour, a major transportation artery is shut down for an hour or more, the flight pattern of an aircraft is altered, there is fire, spillage or suspected contamination

337. COGCC Form 19. SPILL/RELEASE REPORT

A spill or release of E&P waste or produced fluids shall be reported to the Director on a Spill/Release Report, Form 19 pursuant to the reporting requirements in Rule 906.

906. SPILLS AND RELEASES

a. **General.** Operators shall, immediately upon discovery, control and contain all spills/releases of E&P waste or produced fluids to protect the environment, public health, safety, and welfare, and wildlife resources. Operators shall investigate, clean up, and document impacts resulting from spills/releases as soon as practicable. The Director may require additional activities to prevent or mitigate threatened or actual significant adverse environmental impacts on any air, water, soil or biological resource, or to the extent necessary to ensure compliance with the concentration levels in Table 910-1, with consideration to WQCC ground water standards and classifications.

b. **Reporting spills or releases of E&P Waste or produced fluids.**

(1) Report to the Director. Operators shall report a spill or release of E&P Waste or produced fluids that meet any of the following criteria to the Director verbally or in writing as soon as practicable, but not more than twenty-four (24) hours after discovery (the "Initial Report").

A. A spill/release of any size that impacts or threatens to impact any waters of the state, a residence or occupied structure, livestock, or public byway;

B. A spill/release in which one (1) barrel or more of E&P Waste or produced fluids is spilled or released outside of berms or other secondary containment;

C. A spill/release of five (5) barrels or more regardless of whether the spill/release is completely contained within berms or other secondary containment.

The Initial Report to the Director shall include, at a minimum, the location of the spill/release and any information available to the Operator about the type and volume of waste involved.

If the Initial Report was not made by submitting a COGCC Spill/Release Report, Form 19 the Operator must submit a Form 19 with the Initial Report information as soon as practicable but not later than 72 hours after discovery of the spill/release unless extended by the Director.

In addition to the Initial Report to the Director, the Operator shall make a supplemental report on Form 19 not more than 10 calendar days after the spill/release is discovered that includes an 8 1/2 x 11 inch topographic map showing the governmental section and location of the spill or an aerial

photograph showing the location of the spill; all pertinent information about the spill/release known to the Operator that has not been reported previously; and information relating to the initial mitigation, site investigation, and remediation measures conducted by the Operator.

The Director may require further supplemental reports or additional information.

(2) Notification to the local government. In addition to the Initial Report to the Director, as soon as practicable, but not more than 24 hours after discovery of a spill/release of E & P Waste or produced fluids reportable under Rule 906.b.(1)A or B, above, an Operator shall provide verbal or written notification to the entity with jurisdiction over emergency response within the local municipality if the spill/release occurred within a municipality or the local county if the spill/release did not occur within a municipality. The notification shall include, at a minimum, the information provided in the Initial Report to the Director.

(3) Notification to the Surface Owner. In addition to the Initial Report to the Director, within 24 hours after discovery of a spill/release of E & P Waste or produced fluids reportable under Rule 906.b.(1)A or B, an Operator shall provide verbal notification to the affected Surface Owner or the Surface Owner's appointed tenant. If the Surface Owner cannot be reached within 24 hours, the Operator shall continue good faith efforts to notify the Surface Owner until notice has been provided. The verbal notification shall include, at a minimum, the information provided in the Initial Report to the Director.

(4) Report to Environmental Release/Incident Report Hotline. A spill/release of any size which impact or threaten to impact any surface water supply area shall be reported to the Director and to the Environmental Release/Incident Report Hotline (1-877-518-5608). Spills and releases that impact or threaten a surface water intake shall be verbally reported to the emergency contact for that facility immediately after discovery.

(5) Reporting chemical spills or releases. Chemical spills and releases shall be reported in accordance with applicable state and federal laws, including the Emergency Planning and Community Right-to-Know Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Oil Pollution Act, and the Clean Water Act, as applicable.

- c. **Remediation of spills/releases.** When threatened or actual significant adverse environmental impacts on any air, water, soil or other environmental resource from a spill/release exist or when necessary to ensure compliance with the concentration levels in Table 910-1 with consideration to WQCC ground water standards and classifications, the Director may require operators to submit a Site Investigation and Remediation Workplan, Form 27.

(1) Such spills/releases shall be remediated in accordance with Rules 909 and 910.

(2) The operator shall make good faith efforts to notify and consult with the affected Surface Owner, or the Surface Owner's appointed tenant, prior to commencing operations to remediate E&P waste from a spill/release in an area not being utilized for oil and gas operations. Such efforts shall not unreasonably delay commencement of remediation approved by the Director.

d. **Spill/release prevention.**

(1) **Secondary containment.** Secondary containment structures shall be sufficiently impervious to contain discharged material. Secondary containment that was constructed before May 1, 2009 on federal land, or before April 1, 2009 on other land, shall comply with the rules in effect at the time of construction. Secondary containment constructed on or after May 1, 2009 on federal land, or on or after April 1, 2009 on other land shall be constructed or installed around all tanks containing oil, condensate, or produced water with greater than 3,500 milligrams per liter (mg/l) total dissolved solids (TDS) and shall be sufficient to contain the contents of the largest single tank and sufficient freeboard to contain precipitation. Operators are also subject to tank and containment requirements under Rules 603. and 604. This requirement shall not apply to water tanks with a capacity of fifty (50) barrels or less.

(2) **Spill/release evaluation.** Operators shall determine and document the cause of a spill/release of E & P Waste or produced fluids and, to the extent practicable, identify and timely implement measures to prevent spills/releases due to similar causes in the future.

Spill Prevention Control and Countermeasure Plan

RANGELY WEBER SAND UNIT RIO BLANCO COUNTY COLORADO

PREPARED FOR:
Chevron USA Production

PREPARED BY:
Olsson Associates
4690 Table Mountain Drive, Suite 200
Golden, Colorado 80403

Seven Sisters Environmental, Inc.
4609 Chokecherry Trail, Unit 4
Fort Collins, CO 80526



Collection Station 12

PREPARED TO COMPLY WITH:
40 CFR Part 112, published July 1, 2010

SPILL PREVENTION, CONTROL, AND COUNTERMEASURE PLAN

FACILITY: RANGELY WEBER SAND UNIT

FACILITY LOCATION: RIO BLANCO COUNTY, COLORADO

OPERATOR: CHEVRON USA, INC.

FACILITY ADDRESS: 100 CHEVRON ROAD

FACILITY ADDRESS: RANGELY, CO 81648

Management Approval

I hereby approve the contents of the facility's Spill Prevention, Control, and Countermeasure Plan (SPCC Plan) and have the authority to commit the necessary resources to implement the SPCC Plan, as set forth in this document, in accordance with the federal requirements of 40 CFR Part 112.

Signature: _____

Designated person accountable for oil spill prevention at the facility:

Name: Mike Rieken

Name: Luke Allred

Date:

Title: Operations Supervisor

Title: Oil Area Manager

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1. General Applicability (§112.1)

General Applicability (40 CFR §112.1)

The Oil Pollution Prevention regulation (40 CFR Part 112) specifies:

“...this part applies to any owner or operator of a non-transportation-related onshore or offshore facility engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, using, or consuming oil and oil products, which due to its location, could reasonably be expected to discharge oil in quantities that may be harmful, as described in part 110 of this chapter, into or upon the navigable waters of the United States or adjoining shorelines...”

The aggregate aboveground oil storage capacity of the Rangely Weber Sand Unit (RWSU) exceeds 1320 gallons (§112.1(d)(2)(ii)) and a fluid release from the facility could reasonably be expected to discharge harmful quantities of oil into or upon navigable waters or the United States (§112.1(b)). The RWSU lies within the Coal Oil Basin, which generally drains northwest to southeast into Stinking Water Creek, an intermittent arroyo running north to south near the middle of the field. Stinking Water Creek drains into the White River that borders the southeast corner of the field. The White River, in turn, runs southwest into Utah joining the Green River in eastern Utah and the Green River drains into the Colorado River in southeastern Utah.

The surface drainage from most facilities goes into Stinking Water Creek before entering the White River. Because of their proximity to the White River, the surface flow on a small number of locations on the southeast end of the field naturally drains via unnamed drainage paths directly into the White River.

§112.1(d)(11) provides an exemption for intra-facility gathering lines subject to the regulatory requirements of 49 CFR part 192 or 195, except that such a line's location must be identified and marked as “exempt” on the facility diagram. Since the gathering lines at the RWSU are not subject to the requirements of 49 CFR 195, no gathering line exemptions are claimed for this facility.

2. Definitions (§112.2)

Definitions (40 CFR §112.2)

Definitions as they apply to 40 CFR Part 112 are supplied in the text (§112.2) of the rule contained in Appendix G of this document.

3. SPCC Plan Requirement (§112.3)

Requirement to Prepare and Implement a Spill Prevention, Control, and Countermeasure Plan (40 CFR §112.3)

§112.3(a)(1) requires that all facilities in operation on or before August 16, 2002, must maintain their SPCC Plan, or amend it, if necessary to ensure compliance with the rule and implement the Plan no later than November 10, 2010¹. The RWSU was in operation before August 16, 2002 and has amended the plan to ensure compliance with the rule.

¹ On October 8, 2010 the EPA extended the compliance date for most onshore facilities by one year – to November 10, 2011. Onshore facilities required to submit a Facility Response Plan (FRP) per the requirements of §112.20 are not eligible for the extension. Since the RWSU is not required to submit an FRP, the extension applies to this facility.

§112.3(d) – Professional Engineer Certification

A licensed Professional Engineer must review and certify this plan for it to be effective.

Professional Engineer Certification

By means of this Professional Engineer Certification, I hereby attest, to the best of my knowledge and belief, to the following:

- I am familiar with the requirements of 40 CFR Part 112 and have verified that this Plan has been prepared in accordance with the requirements of this Part.
- I or my agent have visited and examined the facility(s).
- I have verified that this Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards.
- I have verified that the required inspection and testing procedures have been established as described in §112.7(e) and §112.9(d).
- I have verified that the Plan is adequate for the facility.
- There are no exempted produced water containers at this facility.

Printed Name of Registered Professional Engineer

(Seal)

Signature of Registered Professional Engineer

Date: _____

Registration No.: _____ State: _____

§112.3(e) – Plan Availability

The RWSU is normally attended at least four hours a day so a complete copy of this plan will be kept at the Rangely office shown on the Facility Area Map. The Plan will be available for on-site review during normal working hours.

§112.3(g) – Qualified Facility

The RWSU does not meet the criteria of a “Qualified Facility” and therefore is subject to the conventional requirements of the SPCC rule.

4. SPCC Plan Amendments by RA (§112.4)

Amendment of SPCC Plan by Regional Administrator (40 CFR §112.4)

If the RWSU ever discharges to navigable waters more than 1,000 U.S. gallons of oil in a single discharge or discharges more than 42 U.S. gallons of oil in each of two discharges occurring within any twelve month period, Chevron will submit the following information to the EPA Regional Administrator (Region 8) within 60 days from the time the facility becomes subject to this section:

1. Name of the facility;
2. The operator's name with local contact information;
3. Location of the facility;
4. Maximum storage or handling capacity of the facility and normal daily throughput;
5. Corrective action and countermeasures Chevron has taken, including a description of equipment repairs and replacements;
6. An adequate description of the RWSU, including maps, flow diagrams, and topographical maps, as necessary;
7. The cause of the discharge(s), including a failure analysis of the system or subsystem in which the failure occurred;
8. Additional preventive measures you have taken or contemplated to minimize the possibility of recurrence; and
9. Such other information as the Regional Administrator may reasonably require pertinent to the Plan or discharge.

Chevron will also send complete copies of all information provided to the EPA Region 8 Administrator (outlined above) to:

1. The Division Director of the Water Quality Control Division (WQCD), Colorado Department of Public Health and Environment (CDPHE), and
2. The Director of the Colorado Oil and Gas Conservation Commission (COGCC)

If after review of the submitted material, the EPA Regional Administrator (RA) requires Chevron to amend this SPCC plan, Chevron will either amend the plan as directed by the RA or appeal the requirement as provided in §112.4(d),(e), and (f).

5. SPCC Plan Amendments by Operators (§112.5)

Amendment of SPCC Plan by Owners and Operators (40 CFR §112.5)

Chevron will amend this SPCC Plan when there is a change in the facility design, construction, operation, or maintenance that materially affects its potential for a discharge. Examples of changes that may require amendment of the Plan include, but are not limited to:

- Commissioning or decommissioning containers;
- Replacement, reconstruction, or movement of containers;
- Reconstruction, replacement, or installation of piping systems;
- Construction or demolition that might alter secondary containment structures;
- Changes of product or service; or
- Revision of standard operation or maintenance procedures at a facility

An amendment made under this section must be prepared within six months, and implemented as soon as possible, but not later than six months following preparation of the amendment.

Chevron will complete a review and evaluation of the SPCC Plan at least once every five years. As a result of this review and evaluation, Chevron will amend this SPCC Plan within six months of the review

to include more effective prevention and control technology if the technology has been field-proven at the time of the review and will significantly reduce the likelihood of a discharge from the RWSU. Chevron will implement any amendment as soon as possible, but not later than six months following preparation of any amendment. Appendix A contains the Log of Plan Review and Amendments.

A Professional Engineer will certify all technical amendments to this plan.

6. Qualified Facility Plan Requirements (§112.6)

Qualified Facility Plan Requirements (40 CFR §112.6)

This section does not apply to the RWSU which does not meet the criteria to self-certify as a Qualified Facility.

7. General Requirements (§112.7)

General Requirements for SPCC Plans (40 CFR §112.7)

§112.7(a)(1) – Facility Conformance

The RWSU conforms to all applicable requirements of 40 CFR 112 as detailed in this SPCC Plan. Specifically, the RWSU is defined as an onshore production facility, and is therefore specifically subject to 40 CFR §112.7 and 40 CFR §112.9. Drilling and workover activities may occur on these properties, but are provided to Chevron on a contract basis and each drilling/workover contractor is an independent entity and required to provide their own SPCC Plan as appropriate.

§112.7(a)(2) – Plan Deviations and Equivalent Environmental Protection

There are no SPCC Plan deviations from the rule claimed by Chevron for the RWSU.

§112.7(a)(3) – Physical Layout and Facility Diagrams

The Rangely Weber Sand Unit (RWSU) is located in northwestern Colorado about ten miles east of the Utah line occupying portions of T2N R102W and T2N R103W, 6th P.M. The main office is located on the north side of State Highway 64 near the center of the field and is approximately four miles west of Rangely, Colorado, the nearest population center. The field is approximately 9 miles long (east-to-west) and 4 miles wide (north-to-south). The White River runs through the southeastern corner of the field. Figure 1 in Appendix E contains additional site location information.

The Rangely Weber Sand Unit is an onshore oil production field with multiple owners and operated by Chevron USA, Inc. The oil field is a mature tertiary recovery (water and CO₂ injection) operation with approximately 260 active producing wells and approximately 270 active injection wells. The fluid from the production wells is pumped to one of 27 Collection Stations – primary separation facilities where oil, water, and gas are separated. Oil is sent to Chevron Pipeline Company's storage facilities south of the RWSU; water is pumped to one of the water plants; and the gas flows to the CO₂/NGL plant.

There are two water plants in the field – the Main Water Plant (MWP) and the West End Water Plant (WEWP). The processes at both facilities are nearly identical. Produced water from the collection stations flows through a gathering system into a series of tanks and filters designed to skim off any remaining oil, clean the water, and re-inject clean water back into the formation to enhance oil recovery.

The primary function of the gas plant is to compress field gas for re-injection into the oil reservoir. Locally known as the CO₂/NGL Plant, the gas plant receives gas from the field, extracts Natural Gas

Liquids (NGLs), and compresses the gas for re-injection to improve oil recovery. Because Chevron has been supplementing the field gas with purchased carbon dioxide (CO₂), the recycled gas is now over 90% CO₂ so production of sales gas is not economically viable.

The crude oil is stored in a stock tank owned and operated by Chevron Pipeline, a separate company operated and managed separately from the production facility. Therefore the facilities operated by Chevron Pipeline Company are outside the scope of this SPCC plan.

Generalized and detailed facility diagrams are included in Appendix E. The facility diagrams include:

- The location and contents of each container – including the approximate location of buried lines (no other buried tanks are present at the facility)
- Container capacities for storage tanks – other capacities are detailed in Table 2, pages 27-28
- Secondary containment structures and dimensions
- Product transfer stations and connecting pipes
- Drainage direction
- North arrow
- Approximate scale

§112.7(a)(3)(i) – Type of oil in each container

Oil, as defined in 40 CFR 112.2, is stored in the separation vessels and/or above ground storage tanks (ASTs) at each Collection Station, at the Main Water Plant, at the West End Water Plant, and at the CO₂/NGL Plant. Additional portable tanks are used throughout the field for chemical treatment applications. These tanks are installed with portable secondary containment structures, usually welded carbon steel basins. The location of these portable units change with operational needs, but the location and contents of each portable container is documented and updated in real time by the chemical contractor. A typical location and contents list is supplied in Appendix D. At any time when required, the chemical contractor can be contacted to supply a current list.

An inventory of the materials in the field that are regulated under this SPCC plan is presented in Tables 1 and 2. The locations of fixed tanks and storage units are as indicated in the Facility Diagrams, Figures 2 - 31 in Appendix E.

§112.7(a)(3)(ii) – Discharge Prevention Measures

Each storage tank has a system in place that has been designed and installed in accordance with good engineering practice to prevent discharges. The discharge prevention features are described in Section §112.9(c)(4) on page 29 and include high level alarms, an automated alarm call-out system, equalization lines between adjacent tanks to contain overflows, and breather valves for vacuum protection. All discharge prevention features are inspected at regular intervals with the tank inspections.

Additionally, Rangely's System Control and Data Acquisition (SCADA) system consists of approximately 34 Remote Transmission Units (RTUs) and a host computer. There is one RTU at each collection station and each major facility in the field. Every tank that handles produced water, filtered water, or produced oil is equipped with a high level sensor, a level transmitter, or both. These devices send a signal to the RTU that will generate an alarm whenever a level rises above its specified set point. Except at the NGL/CO₂ Plant, these alarms trigger a beacon at the facility and are sent to the host computer for broadcast over the company radio system. The NGL/CO₂ Plant is manned 24 hours a day so the alarms are enunciated in the control room and activate an audible alarm throughout the plant. In addition, all collection stations are equipped with high level sensors on the emergency pit to

alert the operator of any condition that has caused an influx of the flow to the pit. These pit alarms are tied into the SCADA system, so will be broadcast over the company radio system.

Discharge Prevention also includes training for all appropriate personnel on the handling and transfer of fluids during normal operations (see §112.7(f), page 16 on training and briefings).

§112.7(a)(3)(iii) – Discharge and Drainage Controls

A description of secondary containment and/or diversionary structures or equipment for each storage unit or potential oil discharge point at the facility is included on the Facility Diagrams (Appendix E). The Facility Diagrams also include a description of the type of containment, material of construction, and containment capacity for each secondary containment structure. Containment capacity calculations and/or specifications are provided in Table 2 on pages 27-28. Each secondary containment system, including the walls and floor of the respective system, is capable of containing oil and has been constructed so that any discharge from a primary containment system (such as a tank or pipe) will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

Where secondary containment is achieved through a remote impound basin, the area is graded and diversion berms are installed sufficient to ensure any discharge drains into the containment basin. Diversion berms and drainage directions are indicated on the Facility Diagrams (Appendix E).

§112.7(a)(3)(iv) – Countermeasures

This SPCC plan is used in conjunction with the Rio Blanco County Area Emergency Response Plan (ERP) in the event of a spill or release at the facility.

The overall Emergency Response Plan and Emergency Response Staging Areas are documented in the RWSU Emergency Response Plan. Hard copies of this plan are distributed to key personnel at the Rangely facility. The overall plan is maintained by the RWSU Environmental Specialist and is electronically filed on the Local Area Network (LAN) at F:\ESF&H\ERBook\ Emergbk.doc and F:\ESF&H\VERB\2003

Emergency telephone numbers are listed in Appendix B of this plan.

§112.7(a)(3)(v) – Methods of Disposal

Recovered materials are, to the extent possible, recycled back into the production streams. Otherwise the material is remediated in place in accordance with Colorado Oil and Gas Conservation Commission (COGCC) rules. If 'in-place' remediation is inappropriate because of risk to ground or surface water, then the material will be moved to a secure location prior to remediation or disposal in accordance with COGCC rules. The RWSU operates a remediation landfarm, permitted by the COGCC for E&P wastes generated in the field. In most instances (except when a non-exempt waste is spilled), this facility would be used to dispose and remediate oil-based spilled material.

§112.7(a)(3)(v) – Contact List

Both Company and Agency contacts with phone numbers are provided in Appendix B.

§112.7(a)(4) – Reporting Information

As part of training in Emergency Response procedures, all Rangely personnel are trained in discharge reporting. To ensure accurate consistent reporting to federal and state agencies only certain designated personnel (Operations Supervisor and Health, Environment, and Safety (HES) Specialist) will be trained to report directly to the agencies. All other personnel (potential first responders) are trained to notify the Operations Supervisor or the HES Specialist.

The reporting forms (Appendix B) used by the HES Specialist are designed to elicit the appropriate information, including:

- Facility location
- Contact phone number
- Date and time of the discharge
- Type of material discharged
- Estimate of the total quantity of material discharged
- Estimate of the quantity of harmful quantities of oil discharged to navigable waters of the U.S.
- Source of the discharge
- Description of all impacted media (soil, surface water, ground water, etc.)
- Cause of the discharge, if known
- Damages or injuries associated with the discharge
- Actions being used to stop, remove, and mitigate the effects of the discharge;
- Whether an evacuation may be needed; and
- The names of individuals and/or organizations who have also been contacted

§112.7(a)(5) – Procedures Used When a Discharge Occurs

The Field Coordinator or his delegated representative is responsible for implementing response procedures in the event of an oil spill or discharge emergency. This person has the authority to commit the resources necessary to carry out a response. However, all operating personnel at the Rangely Weber Sand Unit receive training to familiarize themselves with all aspects of the SPCC Plan, facility operations, the location and characteristics of materials handled at the facility, and the location of all records within the facility; and are responsible for proper implementation of response procedures should the Field Coordinator or his representative be unavailable. Reference the map in Figures 1 for location of storage facilities and drainages.

I. Field Coordinator

A. Dispatch company personnel to the location of the spill.

1. If safe to do so, dispatch pumper to shut down wells or equipment contributing to the spill. Close all valves which will help control the spill. Assist in containing the spill.
2. Maintain communication with the pumper.
3. Restrict ignition sources if the material is flammable.
4. Secure the area as off-limits.
5. In the event that the incident poses an immediate threat of fire, explosion, or other detrimental impact to safety, health, or the environment, contact the local emergency response personnel listed in Appendix B.

- B. Contact contractors and dispatch labor, equipment and materials, as needed, to the location of the spill.
 - 1. Contractor to load necessary tools and materials to contain spill.
 - 2. Contractor to transport dirt moving equipment and vacuum trucks to the spill containment site.
- C. As soon as practicable, meet with all on-site personnel and conduct site specific review of potential hazards and applicable safe operating practices. Reinforce TIF (Think Incident Free) principles.
- D. Ensure all appropriate managers are contacted and informed of spill as required by Company Policy.
- E. Contact the Health, Environment, and Safety (HES) Specialist and provide complete spill details.
- F. Immediately advise any private landowners upon whose land the spill has entered or is likely to enter.
- G. Continue to monitor the extent of the spill and supervise containment and cleanup of the spill.
- II. HES Specialist – Evaluate spill details and determine verbal and written reporting requirements as required.
 - A. Make verbal reports to all required Governmental Agencies. Provide written reports to Government Agencies as necessary.
 - B. Provide electronic spill reports to Chevron management and staff as necessary.
- III. Existing Spill Containment Sites – Major facilities are surrounded by earthen or corrugated steel berms.
- IV. Potential Spill Containment Sites – There are no potential spill containment sites other than what have been described in previous sections.

§112.7(b) – Fault Analysis

Experience indicates a reasonable potential for equipment failure in the following scenarios. Direction of flow is references on the Facility Diagrams and rate of flow and total quantity discharged are evaluated below.

Potential Failure Scenarios –

Vessels at Collection Station locations

- Catastrophic tank failure
 - Worst case release volume – volume of tank + production rate until shut in (see planning volumes in Table 2)
 - Maximum rate of release – instantaneous
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill could potentially impact adjacent intermittent drainages – See Figure 1, for the location of each facility relative to drainage systems. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.

- Tank overflow
 - Worst case release volume – up to 2,000 barrels, depending on Collection Station (see Table 2, Production Volume)
 - Maximum rate of release – 1000 barrels per hour
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill could potentially impact adjacent intermittent drainages – See Figure 1, for the location of each facility relative to drainage systems. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.
- Valve leak / failure
 - Worst case release volume – variable depending on location and size of valve. Failure of the loading or drain valves at bottom of a tank could release the volume of the tank + production rate until shut in
 - Maximum release rate – variable depending on location and size of valve. From a fraction of a barrel per hour to an instantaneous rate of approximately 500 barrels / hour based on open-flow rate through a 4" loading valve.
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill could potentially impact adjacent intermittent drainages – See Figure 1, for the location of each facility relative to drainage systems. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.

Flow line leak

- Worst case release volume – variable, up to 100 barrels depending on location and depth buried. Estimate based on experience.
- Maximum rate of release – 100 barrels per hour
- Direction of flow – indicated on Facility Diagram or based on local topography at precise location of leak.
- Containment failure – spill could potentially impact adjacent intermittent drainages. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.

Water Plant Area Tanks

- Catastrophic tank failure
 - Worst case release volume – volume of tank + production rate until shut in (see planning volumes in Table 2)
 - Maximum rate of release – instantaneous
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill would probably impact adjacent intermittent drainages – See Figure 1. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.
- Tank overflow
 - Worst case release volume – approximately 2000 barrels, based on maximum production, alarms and automatic shut downs installed, and fully manned, centrally located facility
 - Maximum rate of release – 4000 barrels per hour
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – potential for contaminating adjacent drainages (Stinking Water Creek) is high. Personnel responding to this type of failure should be

- prepared to contain spill with adsorbent materials, check dams, or booms as appropriate. Spill Containment Facility on White River should be deployed.
- Valve leak / failure
 - Worst case release volume – variable depending on location and size of valve. Failure of the loading or drain valves at bottom of a tank could release the volume of the tank + production rate until shut in
 - Maximum release rate – variable depending on location and size of valve. From a fraction of a barrel per hour to an instantaneous rate of approximately 500 barrels / hour based on open-flow rate through a 4" loading valve.
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – potential for contaminating adjacent drainages is high. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.

Vessels and Storage Tanks at NGL / CO₂ Plant

- Catastrophic tank failure
 - Worst case release volume – 1400 barrels
 - Maximum rate of release – instantaneous
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill would probably impact adjacent intermittent drainages – See Figure 1. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials or check dams.
- Tank overflow
 - Worst case release volume – up to 80 barrels
 - Maximum rate of release – 65 barrels per hour
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill could potentially impact adjacent intermittent drainages – See Figure 1, for the location relative to drainage systems. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.
- Valve leak / failure
 - Worst case release volume – variable depending on location and size of valve. Failure of the loading or drain valves at bottom of a tank could release the volume of the tank + production rate until shut in
 - Maximum release rate – variable depending on location and size of valve. From a fraction of a barrel per hour to an instantaneous rate of approximately 500 barrels / hour based on open-flow rate through a 4" loading valve.
 - Direction of flow – indicated on Facility Diagram
 - Failure of secondary containment – spill could potentially impact adjacent intermittent drainages – See Figure 1, for the location of each facility relative to drainage systems. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.

Truck Loading Spills

- Tank overflow
 - Worst case release volume – Since these tanks are manned truck loading operations, worst case spill volume would be only a few barrels based on the time it takes to shut down the load pump.
 - Maximum rate of release – 400 barrels per hour
 - Direction of flow – indicated on Facility Diagram
 - Containment failure – potential for contaminating adjacent drainages is low due to low volumes and manned operation. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials.
- Valve leak / failure or loading hose leak or failure
 - Worst case release volume – variable depending on location and size of valve. Failure of the loading or drain valves at bottom of a tank could release the volume of the tank. (barrels)
 - Maximum release rate – variable depending on location and size of valve. From a fraction of a barrel per hour to an instantaneous rate of approximately 500 barrels / hour based on open-flow rate through a 4" loading valve.
 - Direction of flow – indicated on Facility Diagram.
 - Containment failure – potential for contaminating adjacent drainages is low due to low volumes and manned operation. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials.
- "Drive away" failures
 - Worst case release volume – Variable depending on tank being unloaded – typically 400 barrels.
 - Maximum rate of release – approximately 500 barrels / hour based on open-flow rate through a 4" loading valve
 - Direction of flow – indicated on Facility Diagram
 - Containment failure – spill could potentially impact adjacent intermittent drainages – See Figure 2, for the location of each facility relative to drainage systems. Personnel responding to this type of failure should be prepared to contain spill with adsorbent materials, check dams, or booms as appropriate.

§112.7(c) – General Secondary Containment

Chevron provides the appropriate containment and diversionary structures designed to prevent discharges to navigable waters of the US. Various secondary containment structures are used throughout the facility and are individually described and quantified in Table 2 (Pages 27-28) and Figures 3-32 (Appendix E).

All secondary containment systems, including walls and floor, are capable of containing oil and are constructed so that any discharge from the primary containment systems will not escape the secondary containment system before cleanup occurs. Containment systems at the RWSU include:

- Dikes and berms sufficiently impervious oil;
- Spill diversion ponds;
- Retention ponds; and
- Sorbent materials

§112.7(d) – Impracticability

All of the Secondary Containment Structures required by §112.7(c) are practicable. Chevron makes no claims of impracticability for secondary containment at the RWSU.

§112.7(e) – Inspections, Tests, and Records

Chevron will conduct inspections and tests required by this part in accordance with written procedures detailed below (Section 9, §112.9(b), (c)(3), (c)(5), (d)(1), and (d)(4)). Written procedures and a record of the inspections and tests, signed by the appropriate supervisor or inspector, will be kept under usual and customary business practices for a period of three years.

§112.7(f) – Personnel, Training, and Discharge Prevention Procedures

(1) The Facility provides the following minimum training to oil-handling personnel prior to assignment of job responsibilities:

- Operation and maintenance of equipment to prevent oil discharges;
- Oil discharge procedure protocols;
- Applicable oil spill prevention (State & Federal) laws, rules, and regulations;
- General facility operations; and,
- The contents of the facility SPCC Plan and applicable pollution control laws, rules, and regulations.

The oil-handling personnel operating the facility are instructed on job responsibilities and duties. They are under the direct supervision of the Production Specialist, who is responsible for establishing performance and duty guidelines. Regular safety meetings are held to discuss a variety of safety procedures and other pertinent job responsibility criteria. A written record of all training is maintained for 3 years.

(2) The Operations Supervisor designated to operate or maintain the facility is the primary person accountable for spill prevention. Mr. Luke Allred staffs this position. The Operations Supervisor is stationed in the Rangely Operations office and has the authority to commit all resources and personnel necessary for spill prevention and control at the facility. Refer to Appendix B for contact information.

(3) The facility conducts prevention briefings for oil-handling personnel at least once a year to assure adequate understanding of the SPCC Plan for the facility. These briefings include:

- Discussion of potential discharges;
- Component failures; and
- Precautionary measures

Spill prevention briefings are held at least once a year during regularly scheduled safety meetings. These briefings will be held to assure adequate understanding of the SPCC plan for the facility and will highlight and describe known discharges as explained in 40 CFR 112.1(b) or failures, malfunctioning components, and any recently developed precautionary measures. Additional briefings will be held if any “near misses” or incidents are noted during the previous month. Sign-in sheets, which include a list of the topics discussed at the briefing, are maintained for documentation.

§112.7(g) – Security (excluding oil production facilities)

The RWSU is an Onshore Production Facility and the provisions of this paragraph of the code are not applicable.

§112.7(h) – Facility Loading Racks

There is not a loading / unloading rack, as defined in §112.2 Definitions, at the RWSU.

§112.7(i) – Brittle Fracture Evaluation

In the event that a field-constructed aboveground container undergoes a repair, alteration, reconstruction, or a change in service that might affect the risk of a discharge or failure due to brittle fracture, or has discharged oil or failed due to brittle fracture failure, the container will be evaluated for the risk of discharge or failure due to brittle fracture. As a result of that evaluation, Chevron will take the appropriate action, if any, recommended to mitigate the risk of brittle fracture failure.

§112.7(j) – Conformance with State Requirements

The facility complies with state requirements imposed by the Colorado Department of Public Health and Environment (CDPHE) as well as the Colorado Oil and Gas Conservation Commission (COGCC) regarding spill reporting and remediation. Chevron has developed a site-specific Spill Reporting Flowchart that details reporting requirements to all applicable regulatory agencies. This flow chart is available for inspection at the Rangely Field office.

Specifically, COGCC rule 906 requires that spills and releases of all produced fluids (oil and water) be controlled and contained immediately upon discovery. Other provisions of the rule that are more stringent than Federal rules include:

- Written reports of all discharges of produced fluids exceeding five (5) barrels, including discharges to contained within berms or impoundments, regardless of risk to navigable waters
- Timely verbal reports (within 24 hours) and follow up written reports of all discharges of produced fluids exceeding twenty barrels
- Timely verbal reports (within 24 hours) and follow up written reports of discharges of produced fluids of any amount that threaten any waters of the state, residence or occupied structure, livestock, or public by-way.
- Timely notification (within 24 hours) to the surface owner or appointed tenant of any reportable spill that impacts or threatens to impact the owner/tenant's land
- Remediation of any impacted soil, surface water, and groundwater to referenced quality standards (900 series rules, Table 910-1)
- Secondary containment requirements for all tanks containing produced water with greater than 3,500 mg/liter total dissolved solids (TDS)

§112.7(k) – Qualified Oil-Filled Operational Equipment

Chevron will apply the general secondary containment requirements to all oil-filled operational equipment (transformers, lube oil systems, gear boxes, etc.) at the RWSU. No alternative requirements to the general secondary containment requirements are employed at this facility.

8. Onshore Facilities, excluding Production (§112.8)

SPCC Plan Requirements for Onshore Facilities (excluding Production Facilities) (40 CFR §112.8)

The RWSU is an Onshore Production Facility and the provisions of this paragraph of the code are not applicable.

9. Onshore Production Facilities (§112.9)

SPCC Plan Requirements for Onshore Production Facilities (40 CFR §112.9)

§112.9(b)(1) – Oil Production Facility Drainage, Containments

At each collection station, secondary containment is achieved through one or two catchment basins constructed downgradient from the process vessels and storage tanks. Drainage from these catchment basins is controlled by gate valves that remain closed and locked except when rainwater is being drained.

Secondary containment structures at locations other than the collection stations where there is a reasonable possibility of discharge as described in 112.1(b), are not equipped with drainage valves. Precipitation that may accumulate in the containment areas are normally allowed to evaporate. No automatic pumps or ejector devices are present in any of the containment areas. If removal of any water accumulated in the containment area is necessary, it will be conducted under the direct supervision of responsible personnel as described in this section.

If enough precipitation collects in the containment area to compromise the capacity of the secondary containment, then the following procedures are followed:

- 1) The retained rainwater is inspected for signs of oil or other contaminants in or on the water. Signs of oil include:
 - a) An oil film on the surface of the water
 - b) A sheen or rainbow on the water indicating trace amounts of oil
 - c) Subsurface sludges or emulsions
- 2) If signs of contamination are detected, then the contained fluids will be recycled back into the process stream or disposed of in accordance with applicable local, state, and federal regulations.
- 3) If no signs of contamination are detected, the bypass valve may be unlocked and opened under responsible supervision to discharge the uncontaminated rainwater
- 4) The drainage valve is then returned to the sealed closed position and locked
- 5) Documentation of the inspection and drainage of the containment basin is recorded. The information documented must include:
 - a) Date and time of the inspection and/or drainage
 - b) Operator and responsible supervisor
 - c) Notes of visual appearance of the water, specifically the presence or absence of signs of contamination
 - d) Approximate volume of the fluid present in the containment area
 - e) Action taken (valve unlocked and opened or alternative disposal method)

A typical example of a Secondary Containment Drainage Log is found in Appendix C of this document. Completed drainage logs will be kept on file with the SPCC documents for a period of at least three years.

§112.9(b)(2) – Oil Production Facility Drainage, Field Drainage Systems

If oil is detected in the containment areas or in field drainage systems (drainage ditches, oil traps, sumps, etc.) the fluid will be removed by vacuum truck and recycled back into the production stream.

§112.9(c)(1) – Bulk Storage Containers, Material of Construction

The material and construction of all bulk storage containers are compatible with the material stored and conditions of storage such as pressure and temperature.

§112.9(c)(2) – Bulk Storage Containers, Sized Secondary Containment

All tanks, tank batteries, and most separation and treating facility installations are provided a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. A few of the smaller separation and treating (i.e., ‘flow-through’ process) vessels are provided with general secondary containment and are subject to the alternative requirements to sized secondary containment described below in §112.9(c)(5).

The following tables contain specific information about each fixed bulk storage container in the RWSU. Table 1 contains a list of the bulk storage containers, their material of construction, and discharge prevention measures. The specific containment structures, volumes, actual containment volumes, and required containment volumes are summarized in Table 2.

Table 1 – Bulk Storage Containers

Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
COLLECTION STATION #1				
Separator 1	Oil / Water	513	Carbon Steel	High level alarm, overflow to tank
Separator 2	Oil / Water	513	Carbon Steel	High level alarm, overflow to tank
Separator 3	Oil / Water	513	Carbon Steel	High level alarm, overflow to tank
Emergency Tank	Oil / Water	5,000	Carbon Steel	High level alarm, overflow to basin
COLLECTION STATION #3, North				
FWKO V-311	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
FWKO V-313	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
Flash Tank V-314	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #3, South				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bonnie Bulk V-309	Oil / Water	793	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-301	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-305	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-307	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #4, North				
FWKO ²	Oil / Water	685	Carbon Steel	High level alarm, overflow to pit
Flash Tank ²	Oil	106	Carbon Steel	High level alarm, overflow to pit
Water Tank ²	Water	403	Fiberglass	High level alarm, overflow to pit
Emergency Tank ³	Oil / Water	5,000	Carbon Steel	High level alarm, overflow to basin
COLLECTION STATION #4, South				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel	Oil / Water	625	Carbon Steel	High level alarm
HP Bulk Vessel	Oil / Water	513	Carbon Steel	High level alarm
Bulk Vessel V-401	Oil / Water	203	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-402	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #5				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bertha	Oil / Water	793	Carbon Steel	High level alarm, overflow to pit
FWKO ²	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-501	Oil / Water	203	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-505	Oil / Water	159	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-502	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-507	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Flash Vessel	Oil	106	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit

² Out of service vessel disconnected from process, still on location

³ December 2010 – SPCC containment will be built prior to commissioning the tank

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Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
COLLECTION STATION #6				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-601	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-605	Oil / Water	203	Carbon Steel	High level alarm, overflow to pit
FWKO	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-602	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Flash Tank	Oil	106	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #8, West				
FWKO ⁴	Oil / Water	685	Carbon Steel	High level alarm, overflow to pit
Flash Tank ³	Oil	116	Carbon Steel	High level alarm, overflow to pit
Water Tank ³	Water	403	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #8, East				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-801	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-805	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-802	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
LP Bulk Vessel	Oil / Water	625	Carbon Steel	High level alarm, overflow to pit
Test 2 Vessel	Oil / Water	373	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #9				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-901	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-905	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-902	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Vessel	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #10				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO V-1003	Oil / Water	272	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1001	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1002	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Tank V-1004	Oil	22	Carbon Steel	High level alarm, overflow to pit
Drip Tank	Oil	466	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #11				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bertha V-1103	Oil / Water	793	Carbon Steel	High level alarm, overflow to pit
FWKO ³	Oil / Water	685	Carbon Steel	High level alarm, overflow to pit

⁴ Out of service vessel disconnected from process, still on location

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Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
Bulk Vessel V-1101	Oil / Water	203	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1105	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1102	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank ⁵	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Vessel	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #12				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1201	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1202	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
LP Bulk Vessel	Oil / Water	272	Carbon Steel	High level alarm, overflow to pit
Test 2 Vessel	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Tank	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #13				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO	Oil / Water	766	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1304	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1305	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1302	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1303	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Tank	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #14				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO ⁴	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1401	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1402	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Fiberglass	High level alarm, overflow to pit
Flash Vessel	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #16, North				
FWKO ⁴	Oil / Water	685	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-1601	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1602	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #16, South				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Flash Tank	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #17				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-1705	Oil / Water	203	Carbon Steel	High level alarm, overflow to pit

⁵ Out of service vessel disconnected from process, still on location

Spill Prevention, Control, and Countermeasure Plan – Rangely Weber Sand Unit

Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
Test Vessel V-1702	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Tank	Oil	9	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #18				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-1801	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1802	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Fiberglass	High level alarm, overflow to pit
Flash Tank	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #19				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-1901	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-1902	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Fiberglass	High level alarm, overflow to pit
Flash Vessel	Oil	2	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #20				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-2001	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2002	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #22				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-2201	Oil / Water	146	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2202	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2203	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Tank	Oil	106	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #24				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO ⁶	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-2401	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-2405	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2402	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2407	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Fiberglass	High level alarm, overflow to pit
Flash Tank	Oil	<1	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #27				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO ⁶	Oil / Water	443	Carbon Steel	High level alarm, overflow to pit
Oil Flash	Oil / Water	443	Carbon Steel	High level alarm, overflow to pit

⁶ Out of service vessel disconnected from process, still on location

Spill Prevention, Control, and Countermeasure Plan – Rangely Weber Sand Unit

Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
Bulk Vessel V-2701	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2702	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #28				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO ⁷	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-2801	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2802	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Carbon Steel	High level alarm, overflow to pit
Water Tank ⁸	Water	300	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #29				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-2901	Oil / Water	121	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-2902	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #30				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO	Oil / Water	513	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-3001	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-3005	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3002	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3007	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank ⁸	Water	403	Fiberglass	High level alarm, overflow to pit
Flash Vessel V-3009	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #33				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
LP Bulk Vessel	Oil / Water	443	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-3301	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3302	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Fiberglass	High level alarm, overflow to pit
Flash Vessel V-3304	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #34, North				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-3401	Oil / Water	111	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3402	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel	Oil / Water	300	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	403	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #34, South				

⁷ Out of service vessel disconnected from process, still on location

Spill Prevention, Control, and Countermeasure Plan – Rangely Weber Sand Unit

Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
Flash Vessel V-3404	Oil	121	Carbon Steel	High level alarm, overflow to pit
COLLECTION STATION #39				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
FWKO ⁸	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Bulk Vessel V-3901	Oil / Water	100	Carbon Steel	High level alarm, overflow to pit
LP Vessel V-3906 ⁷	Oil / Water	466	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3903	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3904	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-3905	Oil / Water	40	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	302	Fiberglass	High level alarm, overflow to pit
Flash Vessel V-3909	Oil	121	Carbon Steel	High level alarm, overflow to pit
Cond. Tank ⁷	Oil	302	Fiberglass	High level alarm, overflow to pit
COLLECTION STATION #47				
Flowline Header	Oil / Water	NA	Carbon Steel	Low Pressure Alarm
Bulk Vessel V-4701	Oil / Water	443	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-4702	Oil / Water	121	Carbon Steel	High level alarm, overflow to pit
Test Vessel V-4703	Oil / Water	121	Carbon Steel	High level alarm, overflow to pit
Water Tank	Water	300	Carbon Steel	High level alarm, overflow to pit
Oil Flash Vessel V-4704	Oil	80	Carbon Steel	High level alarm, overflow to pit
MAIN WATER PLANT				
Skim Tank 1 T-1001A	Oil / Water	16,452	Carbon Steel	High level alarm / shutdown
Skim Tank 2 T-1001B	Oil / Water	16,452	Carbon Steel	High level alarm / shutdown
Filter Feed T-1002	Water	16,452	Carbon Steel	High level alarm / shutdown
Backwash Tank T-1003	Water	5,923	Carbon Steel	High level alarm / shutdown
Skim Oil Tank T-1004	Oil	2,098	Carbon Steel	High level alarm / shutdown
Rueben Tank	Oil / Water	5,802	Carbon Steel	High level alarm / shutdown
Chemical Storage Tank T-1006	Phosphate Scale Inhibitor	210	Carbon Steel	Visual Inspection / attended loading
Sump Tank	Oil / Water	151	Carbon Steel	High level alarm / shutdown
Clearwell Tank T-1007A	Water	16452	Carbon Steel	High level alarm / shutdown
Solids Handling Tank T-1007A	Water / Oily Solids	16452	Carbon Steel	High level alarm
Solids Skim Tank	Oil / Solids	302	Carbon Steel	High level alarm
Truck Loading Tank 1	Water / Oil Mixtures	501	Carbon Steel	High level alarm / attended loading

⁸ Out of service vessel disconnected from process, still on location

Spill Prevention, Control, and Countermeasure Plan – Rangely Weber Sand Unit

Tank / Equipment Information				
ID #	Contents	Volume (bbl)	Construction/ Material	Discharge Prevention Features
Truck Loading Tank 2	Water / Oil Mixtures	501	Carbon Steel	High level alarm / attended loading
WEST END WATER PLANT				
Skim Tank 1 T-8001A	Oil / Water	16,452	Carbon Steel	High level alarm / shutdown
Skim Tank 2 T-8001B	Oil / Water	16,452	Carbon Steel	High level alarm / shutdown
Filter Feed Tank T-8002	Water	16,452	Carbon Steel	High level alarm / shutdown
Clearwell Tank T-8003	Water	16,452	Carbon Steel	High level alarm / shutdown
Backwash Tank T-8004	Water	2,098	Carbon Steel	High level alarm / shutdown
Skim Oil Tank T-8005	Oil	2,098	Carbon Steel	High level alarm / shutdown
Biocide Tank	Chemical Biocide	30	Insulated Polymer	Visual Inspection / Attended loading
Corrosion Inhibitor Tank	Chemical Corrosion Inhibitor	16	Carbon Steel	Visual Inspection / Attended loading
Scale Inhibitor Tank	Chemical Scale Inhibitor	13	Stainless Steel	Visual Inspection / Attended loading
NGL / CO₂ PLANT				
NGL Storage 1 V-013	NGL Product	1,390	Carbon Steel Pressure Vessel	High level alarm / shutdown
NGL Storage 2 V-014	NGL Product	1,390	Carbon Steel Pressure Vessel	High level alarm / shutdown
NGL Sour Storage V-004	NGL Product	1,390	Carbon Steel Pressure Vessel	High level alarm / shutdown
TEG Storage 1 T-001	TEG	467	Carbon Steel	Visual Inspection / Attended loading
TEG Storage 2 T-002	TEG	467	Carbon Steel	Visual Inspection / Attended loading
Lube Oil Storage 1 T-003	Lube Oil	101	Carbon Steel	Visual Inspection / Attended loading
Lube Oil Storage 2 T-003A	Lube Oil	112	Carbon Steel	Visual Inspection / Attended loading
Inlet Separator V-001A	Cond. Liquids	8	Carbon Steel Pressure Vessel	High level alarm / shutdown
Inlet Separator V-001B	Cond. Liquids	8	Carbon Steel Pressure Vessel	High level alarm / shutdown
Hot Oil Skid 1 V-2070	Heat Transfer Oil	136 (entire system)	Carbon Steel Pressure Vessel	Visual Inspection / Process Upset Shutdown
Hot Oil Skid 1 V-3070	Heat Transfer Oil	136 (entire system)	Carbon Steel Pressure Vessel	Visual Inspection / Process Upset Shutdown

Table 2 – Secondary Containment Calculations

[illegible]

Spill Prevention, Control, and Countermeasure Plan – Rangely Weber Sand Unit

[illegible]

Note 1 – Precipitation allowance is based on the 25-year / 24-hr storm event. The allowance is justified by the following:

- Each location is inspected daily by the field operator
- The 25-year / 24-hr storm event is about 2.1" (NOAA Atlas 2, Volume III)
- The average annual precipitation is 10.2" (Western Regional Climate Center, Period of Record 1950 – 2005)
- The average annual pan evaporation rate is approximately 64" annually (Oregon Climate Service, data for Grand Junction, CO, 1962 – 2002)
- Based on Chevron's experience in areas with similar meteorological conditions, residual precipitation within a berm has never been identified as a contributing factor to a spill event where the secondary containment was designed to this standard.

§112.9(c)(3) – Bulk Storage Containers, Inspections

Each container of oil is visually inspected for deterioration and maintenance needs, including the foundation and support of each container located on or above the surface of the ground. Specifically, each day facility operation, personnel tour the facility and visually inspect ASTs, piping, and valves for signs of potential leaks. Inspections which include a visual evaluation of the condition of each storage tank, aboveground piping, valves, and fittings, and an examination of the supporting foundations for each regulated tank, are conducted as part of the regular maintenance program and maintenance needs are recorded on daily reports submitted to the Production Specialist.

In addition to the daily inspections carried out by operations personnel as described above, rigorous written inspections (Level III audits) are scheduled and conducted periodically on all facilities. Written inspection records (Level III Audits) will be kept in the Rangely files for a period of three years.

§112.9(c)(4) – Bulk Storage Containers, Engineering Controls

At all facilities, container capacity is adequate to assure that a container will not overfill if a lease operator is delayed in making regularly scheduled rounds.

At all facilities where more than one tank is installed in the same containment area (see Facility Diagrams), overflow equalizing lines exist between containers so that a full container can overflow to an adjacent container.

For all API tanks with nominal volumes of 210 barrels or greater, vacuum protection is provided by Enardo breather valves (4 oz. pressure and vacuum) and is adequate to prevent container collapse during a pipeline run or other transfer of oil from the container.

Additional engineering controls are provided by the RWSU System Control and Data Acquisition (SCADA) system. Each alarm lights a local beacon, gives a voice alarm over the company radio, and ultimately calls somebody out (automated cell phone call) if there is no timely response. All alarms are visible on computer screens in the Rangely office and individual or groups of wells can be shut down remotely from the office. Alarms in the system include:

- Low instrument air pressure
- High process pressures at Central Battery production vessels
- High levels at the catch tanks, production tanks, and salt water tanks
- High and low process pressures at the wellheads
- The RWSU SCADA will automatically shut down the appropriate systems on high and low pressures at the wellhead and high levels in the salt water tanks

§112.9(c)(5) – Flow-through Process Vessels

In lieu of the sized secondary containment requirements of §112.9(c)(2) and (c)(3) listed above, for flow-through process vessels (treaters, separators, etc.), Chevron will:

- Periodically and on a regular schedule visually inspect and/or test flow-through process vessels and associated components (such as dump valves) for leaks, corrosion, or other conditions that could lead to a discharge of harmful quantities of oil to navigable waters of the US.
- Take corrective action or make repairs to flow-through process vessels and any associated components as indicated by regularly scheduled visual inspections, tests, or evidence of an oil discharge.
- Promptly remove or initiate actions to stabilize and remediate any accumulations of oil discharges associated with flow-through process vessels.

If the RWSU discharges more than 1,000 U.S. gallons of oil in a single discharge, or discharges more than 42 U.S. gallons of oil in each of two discharges within any twelve month period from flow-through process vessels (excluding discharges that are the result of natural disasters, acts of war, or terrorism) then the RWSU's flow-through process vessels become subject to the sized secondary containment requirements of §112.9(c)(2) and (c)(3).

§112.9(c)(6) – Produced Water Containers

While the RWSU has produced water containers eligible for this exemption, their proximity to and connection with associated oil tanks make it impracticable to claim this exemption. The produced water tanks at Rangely will be covered by this SPCC plan as if they contained oil.

§112.9(d)(1) – Facility Transfer Operations, Inspections

As part of the general inspection process described in other sections of this SPCC plan (§112.7(e), §112.9(c)(3), §112.9(c)(5), §112.9(d)(2), and §112.9(d)(4)), RWSU personnel conduct inspections of the following aboveground facility transfer operation appurtenances:

- Transfer operation piping, valves, and flange joints
- Valve glands and bodies
- Drip pans
- Pipe supports
- Pumping well polish rod stuffing boxes
- Bleeder and gauge valves
- Miscellaneous associated appurtenances

§112.9(d)(2) – Facility Transfer Operations, Salt Water Disposal Facilities

As part of the general inspection process described in other sections of this SPCC plan (§112.7(e), §112.9(c)(3), §112.9(c)(5), §112.9(d)(1), and §112.9(d)(4)), RWSU personnel conduct inspections of salt water disposal facilities. The salt water disposal facilities are included in daily inspections by field personnel. Special attention is given to incoming fluids and the possibility of excessive oil due to process upsets. During periods of extreme temperature fluctuations (cold snaps), additional attention is given to the possibility of water system failures.

§112.9(d)(3) – Facility Transfer Operations, Secondary Containment - Flowlines

Flowlines and intra-facility gathering lines at the RWSU are not provided with secondary containment in accordance with § 112.7(c). The RWSU is not required to, and has not prepared, a response plan in accordance with §112.20; therefore the following have been provided in Appendix F as part of this plan:

- A written commitment of manpower, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that might be harmful.
- An oil spill contingency plan following the provisions of part 109 of this chapter.

§112.9(d)(4) – Facility Transfer Operations, Flowline Maintenance

The flowline maintenance program at the RWSU includes procedures to:

- Ensure that flowlines and intra-facility gathering lines and associated valves and equipment are compatible with the type of production fluids, their potential corrosivity, volume, and pressure, and other conditions expected in the operational environment.
- Visually inspect and/or test flowlines and intra-facility gathering lines and associated appurtenances on a periodic and regular schedule for leaks, oil discharges, corrosion, or other

conditions that could lead to a discharge to navigable waters of the US. For flowlines and intra-facility gathering lines that are not provided with secondary containment in accordance with § 112.7(c), the frequency and type of testing must allow for the implementation of a contingency plan as described under part 109 of this chapter.

- Take corrective action or make repairs to any flowlines and intra-facility gathering lines and associated appurtenances as indicated by regularly scheduled visual inspections, tests, or evidence of a discharge.
- Promptly remove or initiate actions to stabilize and remediate any accumulations of oil discharges associated with flowlines, intra-facility gathering lines, and associated appurtenances

Specifically the RWSU flowline maintenance plan requires, all new flowline installations will be pressure tested with water at a minimum of the expected maximum anticipated pressure of the system before burial. The pressure will be maintained while all joints and connections are inspected for leaks but not less than ten minutes. When significant portions of existing lines are excavated for repair or replacement exposing joints and connections, the same test procedure will be followed. Existing, pressurized aboveground flowlines are observed on a routine basis. This pressurized observation is documented annually.

Where there is a history of corrosion, existing flowlines will be evaluated for rate of internal metal loss due to corrosion by analysis of the produced fluids for corrosivity, iron counts or protective chemical residuals, or by the use of coupons or other means available from corrosion specialists or chemical technical sales representatives. Lines with abnormal rates will be monitored at an appropriate frequency.

In areas where internal corrosion is predicted to shorten the expected life of the lines significantly, prevention measures such as chemical treatment, alternative construction materials, protective coatings, or accelerated line replacement will be implemented.

If soil conditions or past experience indicate significant problems with external corrosion, existing lines will be evaluated by a qualified cathodic protection specialist for the implementation of a cathodic protection program or an accelerated replacement schedule. On new installations, alternate materials or protective coatings, and/or cathodic protection will be evaluated.

During repairs on lines which are found to have failed due to corrosion, the adjacent pipe will be inspected for readily apparent corrosion damage and replaced when necessary to restore the line to a condition that will prevent discharges for the remainder of its expected service life. A cathodic protection specialist will inspect cathodically protected lines when they are excavated for repair to check indicators such as IR drop and to supervise the proper handling and re-installation of cathodic protection components during the repair.

To facilitate the early detection of leaks or risks of structural failure, flowlines will be inspected during the annual SPCC inspection. Lines and rights-of-way will also be inspected during routine operations frequently enough to find and repair leaks so that discharges to water are prevented and damage to the environment is minimized.

Buried piping is coated and wrapped. When buried piping is exposed it is inspected for deterioration. If corrosion damage is found, additional examination and corrective action will be taken. Piping which is no in service will be capped, valved, or otherwise restrained to prevent oil spills. Any buried equipment will be visually inspected for corrosion whenever exposed through excavation. All pipe supports at the facility are designed to minimize abrasion and corrosion and to allow for expansion and contraction.

Pipe supports are routinely inspected as part of the general facility inspection described As part of the general inspection process described in other sections of this SPCC plan (§112.7(e), §112.9(c)(3), §112.9(c)(5), §112.9(d)(1), and §112.9(d)(2)). Further inspection and correction will be conducted on the affected metal equipment if problems are identified to minimize the chance for a discharge from facility transfer equipment.

10. Onshore Drilling and Workover (§112.10)

SPCC Plan Requirements for Onshore Drilling and Workover Facilities (40 CFR §112.10)

Work Performed by Independent Third-Party Contractors

This Plan has been prepared for the Chevron USA, Inc., RWSU oil and gas production facility. Drilling activities may occur on these properties, but drilling activities are not covered by this Plan. Drilling activities are provided on a contract basis and each drilling contractor is an independent entity and required to provide their own SPCC Plan as appropriate.

Workover activities are also performed by third-party independent contractors. Each workover contractor is required to provide their own SPCC Plan as appropriate.

11. Offshore Facilities (§112.11)

SPCC Plan Requirements for Offshore Drilling, Production, or Workover Facilities (40 CFR §112.11)

The RWSU is an Onshore Production Facility and the provisions of this paragraph of the code are not applicable.

12. Non-Petroleum Oil Facilities (§112.12)

SPCC Plan Requirements for Non-Petroleum Oil Facilities (40 CFR §112.12)

The RWSU is an Onshore Production Facility (petroleum based) and the provisions of this paragraph of the code are not applicable.

13. Facility Response Plans (§112.20)

Facility Response Plans (40 CFR §112.20)

The owner or operator of any non-transportation related onshore facility that, because of its location, could reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines shall prepare and submit a facility response plan to the Regional Administrator.

The RWSU does not satisfy the Substantial Harm Criteria and therefore is exempt from the requirement to submit a Facility Response Plan. The Certification of the Applicability of the Substantial Harm Criteria (§112, Appendix C) is included on the following page.

CERTIFICATION OF THE APPLICABILITY OF THE SUBSTANTIAL HARM CRITERIA

FACILITY NAME: Rangely Weber Sand Unit
FACILITY ADDRESS: 100 Chevron Road
Rangely, CO 81648

1. Does the facility transfer oil over water to or from vessels **and** does the facility have a total oil storage capacity greater than or equal to 42,000 gallons?

☐ YES ☒ NO
2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons **and** does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area?

☐ YES ☒ NO
3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons **and** is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula⁹) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (59 FR 14713, March 29, 1994) and the applicable Area Contingency Plan.

☐ YES ☒ NO
4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons **and** is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula¹) such that a discharge from the facility would shut down a public drinking water intake¹⁰?

☐ YES ☒ NO
5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons **and** has the facility experienced a reportable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years?

☐ YES ☒ NO

CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

_____ Signature	Oil Area Manager _____ Title
Mike Rieken _____ Name (please type or print)	_____ Date

⁹ If a comparable formula is used, documentation of the reliability and analytical soundness of the comparable formula must be attached to this form.

¹⁰ For the purposes of 40 CFR part 112, public drinking water intakes are analogous to public water systems as described at 40 CFR 143.2(c).

14. Facility Response Training (§112.21)

Facility Response Training and Drills / Exercises (40 CFR §112.21)

As described above, the RWSU does not satisfy the Substantial Harm Criteria and is therefore exempt from this requirement.

Oil Spill Contingency Plan

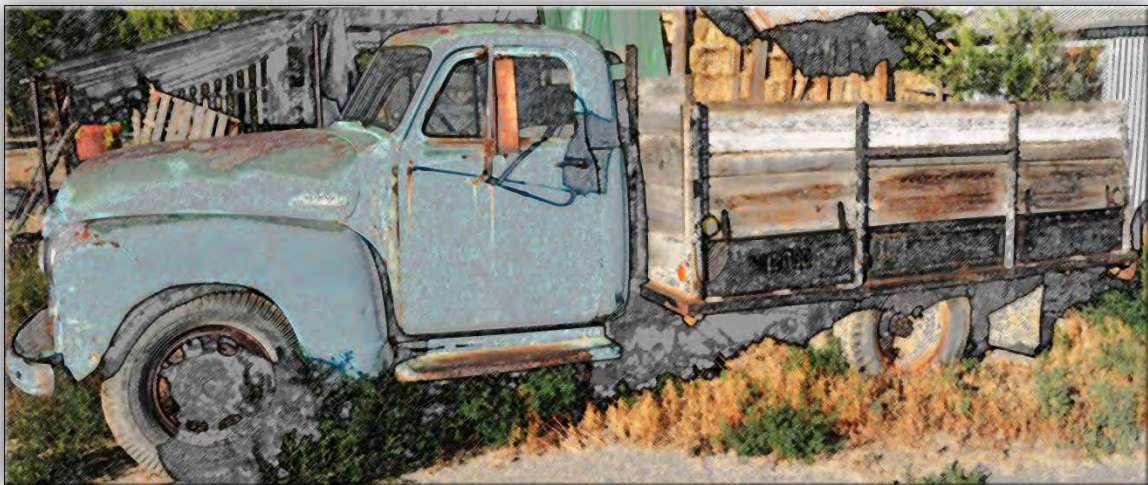
RANGELY WEBER SAND UNIT RIO BLANCO COUNTY COLORADO

PREPARED FOR:

Chevron USA Production

PREPARED BY:

Seven Sisters Environmental, Inc.
4609 Chokecherry Trail, Unit 4
Fort Collins, CO 80526



CLASSIC GMC ADJACENT TO COLLECTION STATION 47

PREPARED TO COMPLY WITH:

40 CFR Part 112.9(d)(3)(i) following the provisions of 40 CFR Part 109

Oil Spill Contingency Plan

FACILITY: Rangely Weber Sand Unit

FACILITY LOCATION: Rio Blanco County, Colorado

OPERATOR: Chevron USA, Inc.

FACILITY ADDRESS: 100 Chevron Road

FACILITY ADDRESS: Rangely, CO 81648

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1. Acronyms and Abbreviations

ACP – Area Contingency Plan
COGCC – Colorado Oil and Gas Conservation Commission
ER(P) – Emergency Response (Plan)
FMT – Facility Management Team
HAZMAT – Hazardous Materials
HAZWOPER – Hazardous Waste Operations and Emergency Response
HES – Health, Environment, and Safety
IC – Incident Commander
NRC – National Response Center
OS – Operations Supervisor
OSC – On-Scene Commander
RCP – Regional Contingency Plan
RP – Responsible Party
RWSU – Rangely Weber Sand Unit
SPCC – Spill Prevention, Control, and Countermeasure
USGS – United States Geological Survey

2. Requirement for an Oil Spill Contingency Plan (40 CFR 112.9(d)(3))

A provision of the Spill Prevention, Control, and Countermeasure (SPCC) rule requires operators to prepare an Oil Spill Contingency Plan. Specifically –

§112.9(d)(3) – For flowlines and intra-facility gathering lines that are not provided with secondary containment in accordance with §112.7(c), unless you have submitted a response plan under §112.20, provide in your Plan the following:

(i) An oil spill contingency plan following the provisions of part 109 of this chapter.

Since there are approximately 1.4 million linear feet of flowline networked across nearly 20,000 acres of highly eroded desert, secondary containment of flowlines is impracticable. The Rangely Weber Sand Unit (RWSU) is not required to, and has not prepared, a response plan in accordance with §112.20; therefore, this Oil Spill Contingency Plan has been prepared to comply with the requirement of §112.9(d)(3)(i).

Many of the provisions required in an Oil Spill Contingency Plan are redundant to existing plans and procedures already in place. The RWSU is organizationally part of Chevron's Rangely Facility Management Team (FMT), so combined spill response resources from the entire area can be efficiently deployed. The following documents are included by reference in this Oil Spill Contingency Plan:

- Rangely Weber Sand Unit SPCC Plan
- RWSU Emergency Response Plans (ERPs)
- Rangely FMT Spill Reporting Flowcharts (Appendix A)
- Mutual Aid Agreement between Chevron Pipeline Company and Chevron USA, Inc. (Appendix C)

These plans, documents, and agreements are maintained and updated separately from this Oil Spill Contingency Plan. The examples of these plans and documents are provided in the Appendices for general reference only. If necessary, the reader is advised to obtain the current versions of these plans from the Rangely Health, Environment, and Safety (HES) Specialist at (970) 675-3839. The HES Specialist position is currently staffed by Mr. Ross Alire.

3. Applicability (§109.1)

The criteria in §109 are provided to assist State, local and regional agencies in the development of oil removal contingency plans for the inland navigable waters of the United States. While not directly applicable to private operators under this paragraph, the language of §112.9(d)(3)(i) incorporates by reference the provisions of §109.

4. Definitions (§109.2)

Definitions as they apply to 40 CFR Part 109 are supplied in the text (§109.2) of the rule contained in Appendix E of this document.

5. Purpose and Scope (§109.3)

The guidelines in §109 primarily establish minimum criteria for the development and implementation of State, local, and regional contingency plans by State and local governments in consultation with private interests to insure safe, timely, efficient, coordinated, and effective action to minimize damage resulting from oil discharges.

The specific purpose and scope of this RWSU Oil Spill Contingency plan is to ensure that the resources available to respond to a spill are coordinated to maximize the effectiveness of the response and minimize duplication of effort.

The primary objective of all spill response efforts is the protection of the public health or welfare of the United States, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches. The development and implementation of this plan shall be consistent with the National Oil and Hazardous Materials Pollution Contingency Plan found in 40 CFR 300.

6. Relationship to Federal Response Actions (§109.4)

It is Chevron's policy and intention to use every available company resource to protect public health and the environment from substantial harm and to effectively contain and clean up any oil spill that discharges from a Chevron facility.

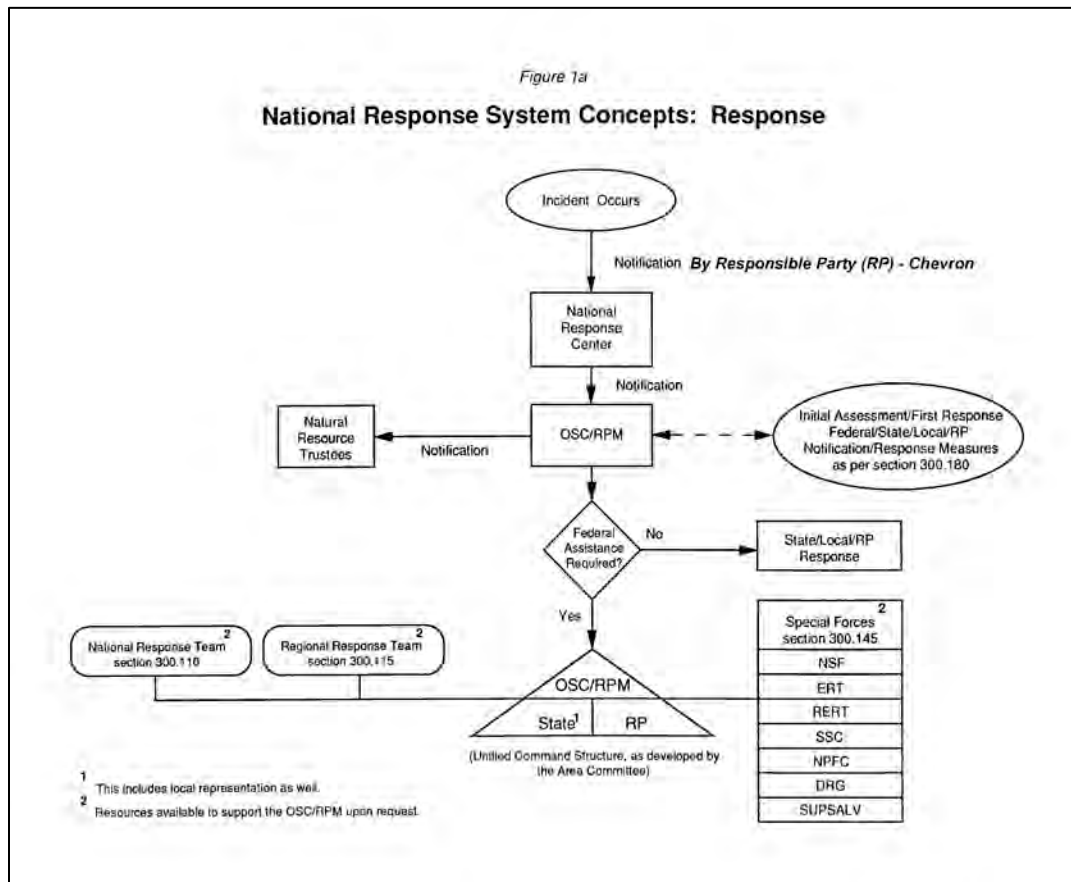
All oil spills that have the potential to impact U.S. waters are promptly reported to the National Response Center (NRC). Upon receipt of a notification of discharge, the NRC is required to promptly notify the Federal On-Scene Commander (OSC). The OSC ensures notification of the appropriate state agency of any state which is, or may reasonably be expected to be, affected by the discharge. The OSC then proceeds to implement the appropriate actions as outlined in the applicable Regional and Area Contingency Plans (RCP, ACP), if necessary.

As outlined in §300.304(d) of the National Oil and Hazardous Materials Pollution Contingency Plan, the OCS shall investigate all reported spills. If such investigation shows that appropriate action is being taken by either the discharger or non-Federal entities, the Federal OCS shall monitor and provide advice or assistance, as required.

If a discharge occurs at the RWSU, the highest-ranking Chevron Operations representative physically present at the facility will assume control of the response effort. It is anticipated that Chevron, as the Responsible Party (RP), will be able to deploy adequate resources to respond to all potential spill events at the RWSU and that the Federal role will be to monitor and advise as described above.

If appropriate containment or cleanup action is not being taken by the discharger or non-Federal entities, the Federal OSC is authorized to take control of the response activity in accordance with 40 CFR 300.305(d) and 322(b) and section 11(c)(1) of the Federal Act.

Figure 1a from §300.105 illustrates the relationship between the RP and the potential Federal response.



7. Development and Implementation Criteria (§109.5)

§109.5(a) – Definition of Authorities

Unless legally usurped by the Federal OSC in accordance with 40 CFR 300.305(d) and 322(b) and section 11(c)(1) of the Federal Act, all responses to oil spill events will be administered by appropriately trained Chevron supervisors. If a discharge occurs at the RWSU, the highest-ranking Chevron Operations representative physically present at the facility will assume control of the response effort. Typically that person would be the RWSU Operations Supervisor, a position currently held by Mr. Luke Allred. The Operations Supervisor is authorized to deploy any equipment or resource required to contain, control, and clean up the spill. In some circumstances another designated Chevron Supervisor qualified as an Incident Commander (IC) may assume control of the response effort.

The Chevron IC will rely primarily on corporate resources to effectively contain and clean up any oil spill that discharges from the RWSU; however local, state, and regional response teams may be consulted

and resources requested at the discretion and under the direction of the Chevron IC. There are five fully qualified, public Hazardous Materials (HAZMAT) emergency response teams organized in Western Colorado. The closest teams are:

- Moffat County HAZMAT Team; Craig, CO
- Grand Junction Fire Department, HAZMAT Response Team; Grand Junction, CO
- Garfield County Multi-Agency HAZMAT Response Team, Glenwood Springs, CO

All three teams have Mutual Aid Agreements with Rio Blanco County and requests for public resources can be coordinated through the Rio Blanco Sheriff's Office or the Rio Blanco Office of Emergency Services at:

Rio Blanco County
John Hutchins, Manager
Rio Blanco Office of Emergency Services
24 Hr Contact: 970-878-9620
Email: rbcem@co.rio-blanco.co.us

Other agencies that may be consulted during an emergency spill response include:

Colorado Division of Emergency Management
Northwest Region
Chuck Vale, Field Manager
(970) 846-3912
chuck.vale@state.co.us

Regional Response Team (Region VIII), Multiple Federal Agencies
Deirdre Rothery, RRT Primary (Coordinator)
Mobile: 303-819-8783
24-hour Tel: 303-293-1788
Email: Rothery.Deirdre@epamail.epa.gov

§109.5(b) – Notification Procedures

In the event of an oil spill or discharge, Chevron has a well documented notification procedure that is posted and used in the event of any environmental release. That notification procedure is published as a series of agency-specific spill reporting flowcharts. Those flowcharts are included here by reference only in Appendix A. The current reporting flowcharts are periodically updated and maintained by the HES Specialist in Rangely, Colorado. The documents in Appendix A are representative, but not intended to reflect any recent amendments or modifications.

(1) Identification of Critical Water Use Areas

The water use area potentially impacted by a discharge from the RWSU is the White River that runs adjacent to the oil field. The Facility Response Planning guidance in Appendix C of 40 CFR 112 (Equation 2.1, Oil Transport on Moving Navigable Waters - Facility Response Planning Distances) was used to calculate the length of the potentially impacted watercourse. Those calculations are attached in Appendix D. United States Geological Survey (USGS) data on near-flood stage stream flows and channel depths were used in the equations.

Based on the §112 guidance, default planning time of 27 hours (24 hours for response and 3 hours for deployment), the water use areas potentially impacted includes 76.8 miles of the White River watercourse downstream from Rangely. The endpoint of the potentially impacted

section of the White River is near the town of Ouray, Utah, just upstream of the White River's confluence with the Green River.

(2) Current Contact List

Emergency Response contact names and numbers are maintained as part of the RWSU SPCC and ERPs (incorporated by reference) and are also listed on the Spill Reporting flowcharts (Appendix A). These plans are maintained in the Rangely Field Office and to avoid inconsistencies, a redundant list of contacts will not be maintained as part of this plan.

(3) Provisions for Access to a Reliable Communications System

The staging center for any RWSU Emergency Response effort will be the Rangely Field Office. Any duly authorized IC or OSC will be granted access to the communications systems located at that office, including:

1. Telephone landlines
2. Internet connections via company computers
3. The company field radio system

(4) Procedure for Requesting Assistance

The Chevron IC or shall evaluate the discharge potential and resources available to contain and clean up the discharge. If the IC judges that the discharge potential exceeds the response capability of the available resources, additional resources from one or more of the following will be requested:

- Chevron Pipeline Company, through the Mutual Aid Agreement
- Chevron World Wide Response Team
- Public Agency HAZMAT Emergency Response Teams through the Rio Blanco Office of Emergency Management or Sheriff's office

§109.5(c) – Resource Capabilities

The RWSU is a manned 24 hours a day, with call-out capability in the event of a spill event. All Rangely FMT field employees are HAZWOPER trained at Level I or higher. Local contractors available for spill containment and clean-up are listed in the SPCC plan.

(1) Inventory of Applicable Equipment and Materials

The Mutual Containment Material, Equipment, and Manpower Sharing Agreement between Chevron Pipeline Company and Chevron USA, Inc. contains an inventory of equipment and materials that are available at the Rangely field. For reference only, the May 2009 version of that agreement is attached as Appendix C.

Additional equipment is available for larger events through the Chevron World Wide Response team and the Public Agency HAZMAT Emergency Response teams discussed above.

(2) Estimate of Equipment, Materials, and Supplies Required

A worst case discharge at the RWSU is calculated to be 17,000 barrels of oil – the shell capacity of the largest storage vessel at the plant. Most of the adverse environmental impact of an oil discharge at the facility will be contained along the first mile of stream bank downgradient from the facility because of booms and oil recovery equipment stored adjacent to the White River that can be deployed immediately. Field employees are trained periodically trained as necessary in boom deployment and oil recovery activities.

The equipment and materials available locally and through the Mutual Aid Agreement (Appendix C) is sufficient to respond to the much larger potential discharge from the Chevron Pipeline Facility at Rangely. Based on these factors, the equipment and material stored at the RWSU, along with additional equipment available from Chevron Pipeline Company is judged to be adequate to contain and remove oil from a worst-case discharge.

(3) Mutual Aid Agreements

As noted above, Chevron USA, Inc. and Chevron Pipeline Company have executed a Mutual Containment Material, Equipment, and Manpower Sharing Agreement to efficiently respond to spill events at the Rangely facilities. A copy of the May 2009 version of that agreement is attached as Appendix C for reference only. This agreement is periodically modified and updated. A current copy of the agreement is available from the Rangely HES Specialist at 970-675-3839.

§109.5(d) – Specific Actions After Discovery and Notification of an Oil Discharge

(1) Oil Response Operating Personnel

All Chevron field employees are HAZWOPER trained to a least Level II. Most experienced field Employees are trained to Level II and selected supervisors within the Rangely FMT are trained to Level V. The initial oil response operating personnel consists of the operations employees on duty at the time of the spill. If the magnitude of the spill requires additional support, the Rangely FMT Operations Supervisor (OS) or IC will call in available off-duty employees from the Rangely FMT and, if necessary, from Chevron Pipeline through the Mutual Aid Agreement.

(2) Oil Discharge Response Coordinator

The designated Oil Response Coordinator at the RWSU is the Operations Supervisor, a position currently staffed by Mr. Luke Allred, trained as an on-scene Incident Commander. Mr. Allred's contact information is listed in the SPCC and ER Plans.

(3) Response Operations Center

The staging center for any RWSU Emergency Response effort will be the Rangely Field Office. The location of the office is near the center of the field as shown on Figure 1. As noted above, this office is equipped with reliable communications systems consisting of:

1. Telephone landlines
2. Internet connections via company computers
3. The company field radio system

(4) Appropriate Response Measures

The size of the spill response effort will depend on the size of the spill and its potential for substantial harm to the public health and environment. Small, isolated spills are usually contained and removed by employees on duty at the time of the spill, along with local third party contractors. As the size and risk potential of the spill increase, the response is commensurately elevated in the following stages:

1. Off-duty Rangely FMT employees and contractors are called in to work,
2. Equipment and personnel are requested through the Mutual Aid Agreement with Chevron Pipeline Company
3. The Chevron World Wide Spill Response Team is contacted
4. Assistance is requested from public agency HAZMAT teams (this option may be employed earlier in the process, depending on the immediacy of the potential risk and the location and availability of the various responders at the time of the discharge).

General spill response actions are outlined in the RWSU SPCC Plan, a separate document that is kept on-site to be used in concert with this plan. For continuity, an outline of the spill response procedures from the SPCC Plan is summarized here and organized by personnel-specific responsibilities:

- I. Operations Supervisor or Field Coordinator
 - A. Dispatch company personnel to the location of the spill.
 1. If safe to do so, dispatch pumper to shut down wells or equipment contributing to the spill. Close all valves which will help control the spill. Assist in containing the spill.
 2. Maintain communication with the pumper.
 3. Restrict ignition sources if the material is flammable.
 4. Secure the area as off-limits.
 5. In the event that the incident poses an immediate threat of fire, explosion, or other detrimental impact to safety, health, or the environment, contact the local emergency response personnel listed in Appendix B.
 - B. Contact contractors and dispatch labor, equipment and materials, as needed, to the location of the spill.
 1. Contractor to load necessary tools and materials to contain spill.
 2. Contractor to transport dirt moving equipment and vacuum trucks to the spill containment site.
 - C. As soon as practicable, meet with all on-site personnel and conduct site specific review of potential hazards and applicable safe operating practices. Reinforce TIF (Think Incident Free) principles.
 - D. Contact appropriate managers as required by Company Policy.
 - E. Contact the Health, Environment, and Safety (HES) Specialist and provide complete spill details.
 - F. Immediately advise any private landowners upon whose land the spill has entered or is likely to enter.
 - G. Continue to monitor the extent of the spill and supervise containment and cleanup of the spill.
- II. HES Specialist – Evaluate spill details and determine verbal and written reporting requirements as required.
 - A. Make verbal reports to all required Governmental Agencies. Provide written reports to Government Agencies as necessary.
 - B. Provide electronic spill reports to Chevron management and staff as necessary.

- III. Existing Spill Containment Sites – Major facilities are surrounded by earthen or corrugated steel berms.
- IV. Potential Spill Containment Sites – There are no potential spill containment sites other than what have been described in previous sections.

The Operations Supervisor or his delegated representative is responsible for implementing response procedures in the event of an oil spill or discharge emergency. This person has the authority to commit the resources necessary to carry out a response. However, all operating personnel at the RWSU receive training to familiarize themselves with all aspects of the SPCC Plan, facility operations, the location and characteristics of materials handled at the facility, and the location of all records within the facility; and are responsible for proper implementation of response procedures should the Operations Supervisor or his representative be unavailable.

(5) Priority of Water Course Protection

The White River is the primary watercourse to be protected. No other watercourse is at significant risk from a discharge from the facility.

§109.5(d) – Recovery of Damages and Enforcement

This paragraph of the rule applies to public response teams and regulatory agencies and is not applicable to Oil Spill Contingency Plans for private operators

8. Coordination (§109.6)

This section of the rule applies to the plans developed by State and local governments and does not apply to Oil Spill Contingency Plans for private operators.