

**TABLE OF CONTENTS**

G10 SITE PREPARATION ..... 2

G1030 SITE EARTHWORK ..... 2

1.0 SITE GRADING, EXCAVATION, AND DISPOSAL..... 2

2.0 EARTHWORK..... 3

3.0 COMPACTION..... 3

4.0 NCB COMPLIANCE (NEPA, CULTURAL, AND BIOLOGICAL RESOURCES) ..... 3

5.0 ENVIRONMENTAL RESTORATION ..... 4

6.0 STORM WATER COMPLIANCE..... 4

**RECORD OF REVISIONS**

<b>Rev</b>	<b>Date</b>	<b>Description</b>	<b>POC</b>	<b>OIC</b>
0	6/28/99	Revised to become Chapter 3 of Facility Engineering Manual (FEM), superseding Civil Facilities Engineering Standards, Volume 3, Revision No. 8, 6/5/98.	Edward J. Hoth <i>FWO-UI</i>	Dennis McLain <i>FWO-FE</i>
1	8/16/04	Chapter divided into four sections based on UniFormat. Complete revision. FEM now ESM.	Edward J. Hoth <i>FWO-UI</i>	Gurinder Grewal <i>FWO-DO</i>
2	10/27/06	Administrative changes only. Organization and contract reference updates from LANS transition. IMP and ISD number changes based on new Conduct of Engineering IMP 341. Master Spec number/title updates. Other administrative changes.	Edward J. Hoth <i>MSS-UI</i>	Kirk Christensen, <i>CENG</i>
3	05/27/15	Added stormwater runoff requirements for Federal projects under EISA Section 438, removed material listed in specifications, and other minor technical and admin updates.	Jerome Gonzales, <i>ES-UI</i>	Mel Burnett, <i>ES-FE</i>

**CONTACT THE CIVIL ENGINEERING STANDARDS POC**  
for upkeep, interpretation, and variance issues

<b>Ch. 3, G10</b>	<a href="#"><u>Civil POC/Committee</u></a>
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## G10 SITE PREPARATION

### G1030 SITE EARTHWORK

#### 1.0 SITE GRADING, EXCAVATION, AND DISPOSAL

- A. Accomplish site grading in a manner which will cause the least disturbance to the natural terrain. Preserve and protect existing native vegetation and trees and shrubs on or adjacent to the construction site, which do not unreasonably interfere with construction operations. Scalp and stockpile the topsoil within the limits of disturbance for use in landscaping and re-vegetation operations upon completion of construction.
- B. Establish grades such that site drainage is away from all structural foundations and open utility excavations. Good engineering practice requires at least a one-half (0.5) foot drop in 10 feet away from the structure. In general, surface drainage systems are preferred over closed-conduit systems. Divert roof runoff away from exterior door openings and walkways. During design, consider the effect of water and wind erosion upon the altered drainage patterns adjacent to new structures. Design must give consideration to winter shade conditions, i.e., north sides of structures, and heavy vegetation. Take precautions to preclude the continuation or acceleration of soil erosion at the project site.
- C. Present elevations necessary for proper site grading on the grading plan. Attempt at achieving an earthwork balance during design. If an earthwork balance cannot reasonably be achieved due to existing site conditions, suitable sources of borrow material must be established prior to construction. Coordinate site selection for borrow pit operations with the LANL Subcontract Technical Representative (STR) or LANL MSS project coordinator.
- D. Specify suitable materials and methods of placing and compacting backfill for buildings, parking areas, roads, loading areas, utility trenches, and the general site within the construction documents.
- E. The grading design shall provide existing and new contours at an interval of 2 ft. and spot elevations shown for grade changes and structure elevations. Provide cross sections where practical and earthwork quantities are substantial. After construction is complete, including clean up, finish grading to the final contours as shown on the drawings shall conform to a tolerance of plus or minus 0.1 ft. Refer to LANL Master Specifications Section [31 2000](#), Earth Moving.
- F. Convey excess material generated during site grading operations to the Los Alamos County sanitary landfill, or other designated locations. Coordinate through the LANL STR or LANL MSS project coordinator.
- G. Refer to LANL Master Specifications Section [01 5705](#), Temporary Controls and Compliance Requirements, for additional requirements on topics such as Erosion and Sediment Control, Storm Water Management, Site Stabilization, Spill Control and Response, Debris Control, Air Quality, Dust Suppression, Rodent Control, Environmental Restoration Sites, Hazardous Waste, and Traffic Control.

## 2.0 Earthwork

- A. Natural soil shall not have a finished slope steeper than 2 horizontal to 1 vertical (2:1). Undisturbed volcanic tuff shall not have a finished slope steeper than 1 horizontal to 6 vertical (1:6).
- B. Define subgrade preparation as a minimum the top 6 to 12 inches of site work under structural foundations slabs and pavement. It shall be scarified, moistened to optimum conditions, and compacted to 95% of maximum density. If unsound areas, soft spots, are discovered the areas shall be removed and replaced with structural backfill. Limit elevation tolerance to plus or minus 0.05 ft. per 10 ft. in any direction from specified grade and cross section. Finish slopes may exceed a 2:1 slope in special cases when recommended by a registered professional geotechnical engineer.

## 3.0 Compaction

- A. Density: Determine optimum density in accordance with ASTM D6938 or ASTM D1557. Determine field control of density of in-place material in accordance with the Nuclear Method (ASTM D6938) or the Laboratory Determination (ASTM D4253) for relative density of cohesionless soil.
- B. Moisture Content: Field control of moisture content shall be determined by the Nuclear Method (ASTM D6938) or the Laboratory Determination (ASTM D4253) for relative density of cohesionless material.
- C. Compaction: Comply with Table G1030-1 requirements for approved material, moistened to optimum conditions, and placed in layers not to exceed 8 inches before compaction.

TABLE G1030-1  
Compaction Requirements

% of Maximum Density	Type of Material
95	Structural fill, embankment, backfill, subgrade and base course under building floor slab, concrete sidewalks, and paved areas.
90	General area grading, backfill, and embankments not under paved area.
90	Sand bedding for underground utility system, except under roadways where density shall be 95%.

- D. Refer to LANL Master Specifications Section [31 2000](#), Earth Moving, for additional requirements.

## 4.0 NCB Compliance (NEPA, Cultural, and Biological Resources)

- A. The purpose of the NEPA, Cultural Resources, and Biological Resources (NCB) process is to ensure that all new and modified programmatic and facility activities (1) consider environmental issues in planning, (2) comply with NCB legal requirements, and (3) incorporate measures necessary to mitigate the effects of activities on environmental

resources, including Threatened & Endangered Species, Floodplains, Wetlands, Historic Buildings, and Archaeological sites.

- B. The LANL STR or LANL MSS project coordinator will complete the Project Review and Requirements Identification (PRID) Process as necessary prior to design. Completing the (PRID) process will ensure that the LANL Air Quality, Cultural Resources, Environmental Programs, Waste Compliance, and LANL Environmental Compliance Programs (ENV-CP) Groups or a trained NCB Reviewer screens all necessary projects and activities. Contact the LANL STR or Project Coordinator to obtain the LANL NCB requirements identified through the (PRID) Process. Incorporate identified requirements into the project's design in order to avoid adverse effects to cultural and biological resources.

## 5.0 Environmental Restoration

- A. For projects that disturb soil or cause storm water runoff to cross a Potential Release Site (PRS), including Solid Waste Management Units (SWMUs), appropriate Best Management Practices (BMPs) shall be implemented as indicated in the design or identified in the SWPP Plan. Specific storm water controls may also be required under regulatory agreements with the New Mexico Environment Department.
- B. The LANL STR or LANL MSS project coordinator will complete the Project Review and Requirements Identification (PRID) Process as necessary prior to design. Completing the (PRID) process will ensure that Environmental Restoration requirements are identified. Contact the LANL STR LANL MSS project coordinator to obtain Environmental Restoration requirements identified through the (PRID).
- C. Process. Incorporate identified requirements into the project's design.
- D. Contact the LANL Environmental Corrective Actions Program Group or the Waste Management and Regulatory Compliance Group or the PRID Administrator for more information.

## 6.0 Storm Water Compliance

- A. Storm Water Management Criteria
  - 1. All projects, regardless of size, shall utilize appropriate BMPs, as indicated in the design or identified in the SWPP Plan and as necessary, to control the discharge or migration of pollutants, including sediment, from disturbed areas. These BMPs may additionally be required to meet State and Federal regulatory requirements.
  - 2. Refer to Part 6.E and the LANL [Storm Water BMP Manual](#) for guidance on BMP selection, design, and use. Additional information on BMP use is provided in LANL Master Specifications Sections [32 9219 Seeding](#); [32 9300 Plants](#); [01 5705 Temporary Controls and Compliance Requirements](#); and the Landscaping Section, G2050, of ESM Chapter 4, Architectural.

B. EISA Section 438 Compliance

1. All Federal facility development or redevelopment projects with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. Refer to ESM Section G20GEN (*I.O.B*) for guidance.

C. NPDES CGP

1. Projects where construction activities disturb one (1) acre or more -- or where activities are part of a EPA defined larger “common plan” of development that disturbs 1 acre or more -- are required to obtain permit coverage to discharge storm water from the site in accordance with the EPA’s National Pollutant Discharge Elimination System (NPDES) Construction General Permit (GCP). Submission of a Notice of Intent (NOI) to EPA is required to obtain Permit coverage.
2. Projects subject to NPDES CGP requirements must develop a Storm Water Pollution Prevention (SWPP) Plan prior to obtaining Permit coverage. An SWPP Plan identifies project activities, describes potential pollutant sources, and identifies the BMPs to minimize the potential for erosion and discharge of potential. Contact the LANL ENV-CP Group for more information on NPDES requirements.
3. LANL will provide a SWPP Plan for the project. A/E and Subcontractor personnel shall provide assistance in SWPP Plan preparation through the following:
  - a. Provide the ENV-CP Group with the necessary design information in sufficient format and detail to complete the SWPP Plan.
  - b. Prepare design drawings and specifications that correspond with the SWPP Plan and NPDES Permit requirements. Project documents must specify the methods, materials, and procedures associated with the temporary and permanent stabilization of disturbed areas.
  - c. Work with the LANL ENV-CP Group to develop documentation that the specified BMPs prevent an increase in sediment yield and flow velocity from pre-construction, pre-development conditions.

D. 404/401 Permits

1. If project construction activities involve crossing, working in, or otherwise disturbing a watercourse, Clean Water Act Section 404 Dredge and Fill Permit coverage from the U.S. Army Corps of Engineers and a New Mexico Environment Department Section 401 Water Quality Certification may be required. A watercourse is defined as “any river, creek, arroyo, canyon, draw, or wash, or any other channel having defined bed and banks with visible evidence

of the occasional flow of water or high water mark.” The Permit and Certification must be obtained prior to performing any work in a watercourse. Allow at least one to two months for 404/401 Permit Applications.

2. 404/401 Permits will require the implementation and specification of BMPs. Identification of excavation and fill material quantities will also be required. The drawings shall clearly show the watercourse area and identify the required BMPs.
3. The ENV-CP Group will file the 404/401 Permit Application and review the BMPs identified in design documents to ensure compliance with Permit requirements. All information required for the permit application shall be forwarded to the ENV-CP Group by the LANL STR Project Coordinator for inclusion in the Permit Application. Contact the ENV-CP Group for more information.

E. New Mexico Environment Department Notices of Intent

1. Fertilizer, hydraulically applied mulches, soil stabilizing agents, and other substances applied to the ground may require that a Notice of Intent (NOI) to Discharge be submitted to the New Mexico Environment Department (NMED). Contact the LANL ENV-CP Group for more information and to determine whether substances to be used are covered under an existing lab-wide NOI.
2. Substances applied to the ground shall not be applied in a watercourse.

F. BMP Guidance

1. Best Management Practices (BMPs) are measures used to prevent or mitigate pollution from any activity. They include processes, procedures, schedule of activities, prohibitions on practices, and other management practices to prevent or reduce water pollution. They include measures for stabilization, sediment and erosion control, and storm water management and can generally be broken down into two categories – structural and non-structural. Examples of non-structural BMPs include minimizing removal of established vegetation, good housekeeping, preventative maintenance, employee training, record keeping and reporting, visual inspections, and spill prevention and response. Some examples of structural BMPs are detention ponds, silt fence, gravel bags, straw wattles, earth berms, culvert inlet and outlet protection, riprap, turf reinforcement mats, and construction entrances/exits. Refer to the LANL [Storm Water BMP Manual](#) for guidance on BMP selection, design, and use.
2. When soil is disturbed, implement a combination of erosion and sediment controls. Erosion controls manage sediment movement at the source. Sediment controls retain sediment that has eroded before the sediment leaves the site.
3. Permanent BMP Requirements
  - a. Design permanent post-construction storm water management devices and sediment controls to be installed during the construction process to control pollutants in storm water discharges after construction operations

have been completed. Such measures include but are not limited to perennial vegetation, storm water detention ponds with controlled outlet structures, sediment basins, turf reinforcement mats, and rock check dams.

- b. A turnover process for acceptance of permanent BMPs must be documented by the responsible LANL FOD).
- c. Stabilize all unpaved areas and areas not covered by permanent structures or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles). Achieve stabilization by covering soil with measures including, but not limited to native perennial vegetation, asphalt, concrete, base course, gravel, or riprap. Avoid the use of impermeable surfaces when possible.
- d. Place velocity dissipation devices at discharge locations and along the length of any outfall channel to provide a non-erosive flow velocity from the structure to a water course so that natural physical and biological characteristics and functions are maintained and protected (e.g., no significant changes in the hydrological regime of the receiving water).
- e. For other areas of concentrated flow such as drainage ways, steep slopes, and compacted earth surfaces, provide appropriate energy dissipating devices. These include such controls as riprap, turf reinforcement mats, check dams, and waterbars.
- f. If permanent BMPs can be utilized during the construction phase to meet the objectives of temporary sediment and erosion controls, specify their installation in lieu of temporary controls.

#### 4. Channel Velocity Control

- a. Riprap— Use riprap to dissipate energy and reduce velocity in channels subject to erosion and to prevent scour at hydraulic structure inlets and outlets.
  - Appropriately size riprap taking into account uniform flow depth, shear stress at maximum flow depth, permissible shear stress, and flow velocity. Identify permissible shear stress using published values or by calculating the value with the following equation:  $\tau_p = 4.0 D_{50}$ , where  $D_{50}$  is in feet. Also ensure that stone size is adequate to withstand movement due to flow velocity (i.e., prevent rolling or migration).
  - Riprap thickness shall be 12 inches or equal to the diameter of the largest rock size in the gradation (approximately 1.5-3 times  $D_{50}$ ), whichever is greater.



- Place filter fabric beneath riprap applications. The fabric must be able to transmit water faster than the soil and be of sufficient size that the base material does not escape through the fabric.
  - Do not use round stone on channel side slopes steeper than 3:1. Do not use riprap on slopes steeper than 1.5:1.
  - Do not use flat slab-like stones.
- b. Gabions—Consider the use of wire enclosed riprap, gabion baskets, or gabion mattresses if adequate riprap size is not available, if slopes are to steep for standard riprap placement, or for locations of high flow velocity.
- To prevent gabion mattresses from sliding down a slope, stabilize their base with a key trench. The trench depth shall be two times the mattress thickness and the trench width shall be three times the mattress thickness. Within a channel, tie the upstream and downstream ends of the mattress into the bank to prevent currents from unraveling the mattress.
  - The minimum rock size diameter for gabion baskets shall not be less than four inches.
  - The minimum rock size diameter for gabion mattresses shall not be less than three inches.
  - The minimum gabion mattress thickness shall be 1.5 times the largest rock size.
  - Place filter fabric beneath gabion applications. The fabric must be able to transmit water faster than the soil and be of sufficient size that the base material does not escape through the fabric.
- c. Culverts—In channel applications, place riprap or gabions flush with the invert of culverts. The break between a steep slope and a culvert entrance should equal 3-5 times the mean rock diameter of the mattress thickness.
- d. Check Dams—Design the center of check dams (the spillway) at least 6 inches lower than the outer edges. Where applicable, extend abutments 18 inches into the channel bank. Maximum spacing between check dams shall provide that the toe of the upstream dam is at the same elevation as the top of the downstream dam.
- e. Other Methods—Contact Civil Standards POC and ENV-CP Group for advisement and approval prior to use.