FACILITIES MANAGEMENT AND OPERATIONS CENTER

FMOC

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3.0 Civil Design Standards

3.1 Introduction

This chapter describes the criteria, standards, and regulations for designing civil systems at Sandia National Laboratories in New Mexico (SNL/NM). These are the minimum acceptable criteria and standards necessary to result in system designs with satisfactory functional characteristics, durability, and operational suitability. Strive for the best design to suit the circumstances involved, and make that design reflect sound professional judgment at all times. Coordinate efforts with team members from other project disciplines to support the integrated site design approach (see section 2.2 in chapter 2, "General Design Standards and Procedures," of this *Design Standards Manual*).

The following minimum design standards apply to the civil work phase on all projects. For general requirements for all project phases, see chapter 2, "General Design Standards and Procedures," of this *Design Standards Manual*.

For a list of accepted standard construction specifications, standard details, and design guides, see Attachments 3.A and 3.B in chapter 12 of this *Design Standards Manual*. References must be used as indicated in this manual.

3.2 Construction Drawings

This section describes the various drawings, maps, plans, and profiles required for designing civil systems at SNL/NM.

3.2.1 Area Map and Vicinity Map

Prepare a map to show a zoomed-out view of the project site in relation to its location on Kirtland Air Force Base (KAFB). The area map must have a scale of 1 inch = 1 mile or larger.

In addition to the area map, prepare a vicinity map to a maximum scale of 1 inch = 200 feet, or as otherwise directed by the Sandia Delegated Representative (SDR). Where applicable, show haul routes, disposal areas, recycle centers, stockpile locations, contractors' access gate, security checkpoints, major street names, and other pertinent information.

3.2.2 Plans and Profiles

Prepare plan and profile sheets for the following:

- Water (domestic and fire protection), storm drain, sanitary sewer, gas, chilled water loops, and recycle/recovery loops
- Electrical overhead and underground electrical conduit runs
- Other large cables when pulled into long raceway runs
- Road construction and paving improvements, including utilities within roadways
- All duct banks and buried conduit
- All service laterals

Profiles must have an expanded vertical scale and show the line continuous in profile with break lines to depict change in direction, if necessary. Run all stationing on plan and profile sheets from left to right regardless of the direction of the north arrow. Draw associated plan views to detail portions of the plan not adequately detailed on the plan portion of the plan and profile. Underground utility profiles must include the vertical locations of existing underground utilities to minimize conflicts.

Prepare plans, profiles, or cross-sections to describe paving improvements and extensive grading work adequately. Where appropriate, minor grading and shaping may be shown on a site plan by spot elevations in lieu of a profile.

3.2.3 Site Plans

Prepare site plans to a scale of 1 inch = 20 feet, unless otherwise noted in the design criteria, and orient the plans as listed in the SNL *CADD Standards Manual*. Show coordination relating to existing underground utilities, architectural features, mechanical equipment, electrical equipment, landscaping (including vegetation and irrigation lines), and other site features that might affect the project on all site plans to guide trenching and excavation. Accurately locate the existing underground utilities in the construction area.

Do not rely solely on SNL/NM Geographical Information System (GIS) mapping for accuracy. As a minimum, use the GIS maps along with a site visit to verify the accuracy of the information. Collect critical measurements during the site visit or secure the services of a surveyor.

3.2.4 Underground Utilities

Develop a plan to locate and document the depth of cover and dimensions of existing underground utilities where it is pertinent to do so along new utility routes and in areas to be excavated or graded. Provide utility locating methods and services as indicated in the project scope. Services may include potholing using vacuum excavation or ground-penetrating radar as required to properly design the project. Submit a copy of all utility pothole logs to Facilities Management and Operations Center (FMOC) Infrastructure Engineering. Request a copy of up-to-date existing site data files following the process outlined in the SNL *CADD Standards Manual*. Review current global positioning system (GPS) data in the area of the project to minimize subsurface utility investigation requirements.

Add the following note to the general notes section of the title sheet for projects that include existing underground utilities work:

Caution—When Excavating

The locations of all underground utilities shown are approximate. The contractor must verify the horizontal and vertical location of all underground utilities prior to the start of construction. The contractor must not interfere with utility line operations and must coordinate all work affecting existing utilities with SNL/NM for each utility, and must notify the SNL/NM Construction Manager (CM) promptly of any problems or conflicts encountered. Further, the contractor must obtain an excavation permit prior to start of excavation. See the project specifications for other requirements.

3.2.5 Drawings Required for Construction

The following sections provide lists of drawings required for a typical project. To illustrate the scope of a project, an approximate list of the plans and drawings required is provided in the design criteria for each discipline. If a project does not have design criteria, see chapter 2, "General Design Standards and Procedures," of this *Design Standards Manual* for information on drawing organization and arrangement of the overall construction drawings set. The CADD design files for all projects must conform to the requirements of the *CADD Standards Manual*. Infrastructure drawings and organization within the construction drawings set include, but are not limited to, the following:

1. Title Sheet: Include job title, project number, contract number, vicinity map, and index of drawings. If the index is extensive it may be placed on a separate Index of Drawings sheet.
2. Vicinity Map: Map showing a zoomed-out view of the project site in relation to its location on KAFB at a scale of 1 inch = 1 mile or larger (can be combined with Title Sheet or Site Plan for small jobs).
3. Site Layout Plan: Show general notes, limits of construction, fences, access, storage areas, street names, alignment of temporary fencing enclosing work areas, and other items needed to convey accurately this portion of the design to the contractor. Provide SNL/NM control monuments with ties to new construction, if a site survey is not provided in the design drawings.
4. Traffic Control Plan: Provide traffic control for pedestrian and vehicular traffic phased with the demolition and construction activities of the project.
5. Removal or Demolition Plan: Show all existing facilities and infrastructure to be removed and pertinent phasing. If required for modifications work, include a site survey.
6. Grading Plan: Show the buildings considered in the contract, the surrounding area, existing topography (including contours at an appropriate interval), and required elevations referenced to an existing benchmark. Show finished grading and existing grades to determine cut and fill. Show street centerlines properly referenced to the coordinate system. Show utilities, unless separate utility site plans are included in the set.
7. Drainage Plan: Show drainage basins, flow paths, rates, and finished contours unless submitted in a separate drainage report.
8. Exterior Utilities Plan: Show all existing and new utilities, including irrigation lines, where feasible. Include a legend for all existing and proposed utilities.
9. Plan and Profile Drawings: Provide plan and profile drawings for all utilities unless otherwise directed by the Infrastructure Engineer. Show the plan and profile of road construction, as well as survey data and the existing grade at centerline (not required for short access or service drives). Show the plan and profile of new utilities as well as existing and finished grades at centerline.
10. Detail Sheets and Area Plans: For road construction, show typical roadway cross-section, intersection plan with spot elevations as needed, turnouts, special paving area plans, pavement section details, and structure details. For utilities show all special connections, utility vaults, or other information that cannot be shown on the utility plans and profiles.
11. Cross-Section Sheets: For road construction, cut and fill cross-sections at specified stations when requested by the SDR.

12. Exterior Civil Details: Provide reference to standard details or show details for civil site work. All details must be labeled descriptively, and cross-referenced to the applicable plan drawings. See the *CADD Standards Manual* for additional CADD requirements.
13. Site Planting and Irrigation Plans and Details: Show all required information on separate sheets. Follow the advice in applicable sections of the *Campus Design Guidelines* (CDG) for SNL/NM.

3.3 Site Modification and NEPA Review Processes

All site modifications must follow FMOC procedure PCD-076, *Site Modification Review on SNL/NM Controlled Properties within KAFB*. All utility connections must be submitted on a site plan to FMOC Infrastructure Engineering for approval.

> **NOTE** Procedure PCD-076 is in review. Please contact the Project Lead (PL) for guidance in the interim.

Projects at SNL must give consideration to the environment early in the project planning stage. This consideration is documented through the National Environmental Protection Act (NEPA) module of the Integrated Safety Management System (ISMS). Specific SNL requirements for complying with NEPA regulations are found in corporate procedure ESH100.1.EP.2, *Implement NEPA, Cultural Resources, and Historic Properties Requirements*. Contact the Project Lead for additional guidance.

Construction activities within 100 feet of any monitoring well must be coordinated with the SNL/NM Groundwater Protection Program Project Lead. Soil-disturbing construction activities are prohibited with 50 feet of any monitoring well. Any borehole installation within half the distance from the ground surface to the uppermost occurrence of groundwater must be coordinated with the SNL/NM Groundwater Protection Program Project Lead.

3.4 Exterior Utilities

When designing exterior utilities, consider possible future extensions and utility demands. The SNL/NM project team provides direction to allow utilities to be sized to meet future demands. Size and terminate utility systems to accommodate future connections. In general, if expansion is planned, extend utilities to the edge of the site or to a point where connection can be made without damage or disruption to the utility or adjacent structures. Establish utility corridors with each utility having a defined location within the corridor to optimize land use and provide adequate utility separation. Consult with FMOC Infrastructure Engineering during conceptual design to ensure proper connections and sizing. The Infrastructure Engineer responsible for each system reviews and approves all connections to the system in the preliminary and final design phases.

3.4.1 Underground Water Lines

This subsection describes criteria and standards for the design of water distribution systems. It does not cover the criteria necessary for the design of major transmission lines, wells, pumping facilities, or reservoirs. The FMOC Infrastructure Engineering department must approve in advance any departure from the criteria.

All water lines and their connections to existing water lines must be designed and shown on a plan and profile drawing. Drawings must show all details, including required fittings and joint restraints.

Locate distribution lines in a utility corridor whenever possible.

All lines 6 inches or larger must be cement-lined ductile iron pipe in accordance with SNL/NM construction standard specifications and standard drawings. Use of PVC pipe is not allowed for lines 6 inches or larger in diameter.

Size the water mains based on requirements from FMOC Infrastructure Engineering. Service laterals must be sized by the Design Engineer according to the code requirements for the facility. Branches off the main water line must have a gate valve in a valve box to isolate the building or facility from the main. Where possible, the potable water service is to be a branch off the fire service line, with its own gate valve in a yard box.

The minimum depth of cover over all water lines is 36 inches.

The trench for pipe installation must be similar to Type 4 as defined by American Water Works Association (AWWA) C600. Pipe must be bedded in 4 inches of sand, gravel, or crushed stone. Backfill must be compacted to the top of the pipe to approximately 80 percent Standard Proctor, American Association of State Highway and Transportation Officials (AASHTO) T-99.

Unless approved by FMOC Infrastructure Engineering, connections larger than 2 inches must be made by cutting the supply main and inserting a standard tee. The maximum allowable tap using a tapping saddle is 2 inches. When approved by FMOC Infrastructure Engineering for connections larger than 2 inches, tapping sleeves must be used. The size of the tapping sleeve is limited to one half of the nominal pipe diameter. Connections exceeding this requirement must be made by inserting a tee. See SNL Standard Specification 02665, *Underground Water Lines for Domestic and Fire Protection Systems*, for additional tapping requirements.

When the water main supply line is 8 inches or larger, the minimum size fire protection line is 8 inches for any sprinkler system supplying a building designed for Ordinary Hazard Group II or greater. Buildings, T-buildings, mobile offices, and trailers smaller than 10,000 square feet are exempt from the 8-inch-minimum fire line requirement.

Do not run fire protection mains under buildings, including temporary structures, such as mobile offices or trailers.

Locate post-indicator valves (PIVs) on fire protection lines no closer than 40 feet and no farther than 100 feet from the building. If this distance is not feasible, the FMOC Fire Protection Engineer can grant authority to locate PIVs at different distances. Post-indicator valve supervisory switches must be installed for all PIVs and connected to the building fire alarm system. The devices must be electrical; single-pole, double-throw, with normally closed contacts and include design that signals the controlled post-indicator valve is in other than a fully open position.

Three-way fire hydrants with a curb box valve must be provided within 50 feet of all fire department connections. Fire hydrant spacing must not exceed 300-foot intervals. The FMOC Infrastructure Engineering department determines fire hydrant spacing in remote areas and on transmission lines.

All pipes passing under railroad tracks must be encased in a protective metal sleeve, sized at least 2 inches larger in diameter than the water line. Support the pipe in the sleeve per manufacturer's instructions. Seal the ends of the sleeve with resilient caulking material or a preformed plastic boot.

Mechanically restrained joints must be designed and detailed on the construction drawings. See SNL/NM Standard Drawing WU5005STD.

The design of valves within the water system must conform to the following criteria:

- Valve Spacing
  - 2,600 feet maximum between inline valves for lines 16 inches and larger.
  - 1,200 feet maximum between inline valves for lines 14 inches and smaller.
- At the intersection of water lines, the distribution lines in all directions must be valved.
- Fire hydrant legs from mains must be valved.
- Valve Location: Avoid locating valves under parking spaces or locations where the valves might be inaccessible, in sidewalk ramps, and next to fences.
- Valve Types
  - Valves 12 inches and smaller must be gate valves.
  - Valves 14 inches and larger must be butterfly valves.
- Valve Sizing
  - All valves must be the same size as the main lines.
- Air-Relief Valves
  - No air-relief valves or air-relief hydrants are required on lines 8 inches or smaller where there are services on the line. On distribution lines greater than 8 inches, sizing and location of air-relief hydrants must be coordinated with FMOC Infrastructure Engineering.

The SNL Project Lead notifies Environmental Programs and Assurance (4143) when a project at SNL/NM involves new construction or modification of the SNL/NM Water Distribution System. This notification allows SNL/NM to meet obligations related to Safe Drinking Water Act requirements for the operation and maintenance of a public water system on KAFB. Contact the SNL/NM FMOC Water System Engineer for additional guidance and information.

3.4.2 Sanitary Sewer

This subsection describes the criteria, standards, and regulations for the design of sanitary sewer systems. It does not cover the criteria necessary for design of major interceptor sewer, lift station, sewer line rehabilitation, or wastewater monitoring facilities.

3.4.2.1 Septic Tanks and Holding Tanks

If a sewer main is not economically feasible, install a holding tank. Do not design holding tanks for flows greater than 375 gallons per day. Holding tanks should be accessible and capable of supporting wheel, backfill, and other loads if buried.

Septic tanks and dry wells must not be used without the written consent of SNL/NM Environmental Operations.

3.4.2.2 Engineering Design Criteria

Design sanitary sewers to maintain velocities that provide self-cleaning action. See the table in subsection 3.4.2.4 for minimum slopes that provide minimum velocities. Avoid velocities above 10 feet per second

because of possible long-term damage to the pipe. New facility sewer connections located several hundred feet from the existing system should provide capacity for future expansion. At all horizontal changes in the alignment, provide manholes in lines that are 8 inches or larger.

Ensure by visual inspection; drawing research; field survey, dye testing, or both; that plumbing connections are made to appropriate sanitary sewer piping. Do not make piping connections that result in the flow of the sanitary sewer to the storm drain system, and do not connect storm drains to sanitary sewers.

3.4.2.3 Manhole Criteria

Conform to these criteria for manholes:

- Avoid locating manholes in natural or manmade drainage swales, curb lines, and parking lanes and spaces.
- Standard minimum manhole depth is 6 feet, measured from the rim to invert. The FMOC Infrastructure Engineering must approve deviations.
- The required inside diameter for a manhole is determined as follows:
  - Minimum inside diameter is 4 feet.
  - A minimum 9-inch-wide shelf must be provided on each side of each main line within the manhole.
  - Where the main flow changes direction at a manhole, the manhole must be large enough so the centerline radius of curvature of the flow invert is larger than the pipe diameter.
- Flow is not be permitted to change horizontal flow directions by more than 90 degrees in a manhole.
- Invert elevations must be called out for each inlet and outlet at a manhole.
- The drop across manholes is to be as follows:
  - Where the main flow does not change direction at the manhole, the design must provide (1) A slope across the manhole at least equal to the average of the slopes of the incoming and outgoing lines, and (2) a minimum drop of 0.05 feet for lines 36 inches and smaller.
  - Where the main flow changes direction at the manhole, the design must maintain the average of the slopes of the incoming and outgoing lines and compensate for the loss of velocity head caused by the turn. (1) The slope component must be equal to the average of the slopes of the incoming and outgoing lines times the diameter of the manhole. (2) The velocity head component must be determined using the following formula:

    $$\mathbf{h_b = K_b (V^2)/2g}$$

    Where

    h_b = required drop to compensate for loss of velocity head (feet)

    K_b bend coefficient; use 0.4 for 90 degree turn, 0.32 for 45 degree turn, and linear proportioning for other deflection angles (dimensionless)

    V = design velocity of incoming line based on design flow in feet/sec

    g = 32.17 feet/sec^2

    (1) The total drop required through the manhole is the sum of the slope component and velocity head component. (2) The minimum drop through a manhole must be 0.10 feet.

- Where flows converge at a manhole, the inverts should be designed to produce a smooth water surface at design flow with no backwater conditions in any of the incoming lines. Avoid excessive drops that cause turbulence.
- The use of drop connections to manholes (drop manholes) requires FMOC Infrastructure Engineering approval. Drop manholes must conform to SNL/NM standard drawings (see Attachment 3.B in chapter 12 of this *Design Standards Manual*).

- Drop manholes and other manholes with high potential for sulfide gas generation must be designed with corrosion-resistant coating, such as epoxy on interior walls, when directed by FMOC Infrastructure Engineering.
- The maximum distance allowed between manholes is 450 feet.
- When an interim line extension is to be built for a distance less than the reasonable spacing for a manhole installation, FMOC Infrastructure Engineering can allow installation of a "temporary," 8-inch diameter, end-of-line cleanout in lieu of a manhole. The design drawings for such installation must provide a design to the next anticipated, upstream manhole location, with line and manhole beyond the temporary cleanout depicted as "Future."

3.4.2.4 Line Criteria

Conform to these criteria for lines:

- Minimum service connection size allowed: 4-inch inside diameter. Minimum mainline size is 6 inches. Sanitary sewer materials must comply with the requirements of SNL/NM construction standard specifications and standard drawings.
- Table 3.1 lists the minimum slopes considered necessary to obtain minimum allowable velocities of 2 feet per second at 50% full and n = 0.013. Greater slopes than minimum are desirable and are to be provided where possible. Maximum slopes should never result in supercritical flow.

Table 3.1 Minimum Slopes to Obtain Minimum Allowable Flow Velocities

Sewer ID (inches)	Minimum Slope (feet/foot)
6	0.0060
8	0.0060
10	0.0028
12	0.0022
15	0.0015
18	0.0012

- Avoid sections of line between manholes that are flat relative to the upstream line. Continuous flow velocity and capacity should be provided as much as possible.
- Line depths should be sufficient to provide gravity service contiguous to the line. Additional depth might be required to provide gravity services where buildings are located far from the line.
- The main lines are to be located within established utility corridors or as directed by the FMOC Infrastructure Engineer.

- The New Mexico Environment Department (NMED) policy on the proximity of water and sewer lines, with city amendment as follows: *Main lines must be located so that they can be maintained without disturbing any building, structures, sidewalk, curb and gutter, or other utilities.* ***In no case must buildings or structures, temporary or permanent, be built over a sanitary sewer main, a collector, or interceptor line.***

3.4.2.5 Service Connection Criteria

Conform to these criteria for service connections:

- Service connections must be made to the main line except at the end of the main where connection to a manhole is permitted in the manner shown in the standard detail drawings (see Attachment 3.B in chapter 12 of this *Design Standards Manual*).
- Service connections to a manhole are to be made with the invert of the service at the top of the main line.
- Table 3.2 indicates the criteria for constructing service connections to mains.

Table 3.2 Criteria for Service Connections to Mains

Service Size	Main Size	Connection Method
4 inches	8 inches	Insert manufactured tee/wye or core
6 inches	8 inches	Insert manufactured tee/wye or install
6 inches	10 inches and	Insert manufactured tee/wye or core
8 inches	8 inches and	Install manhole

- Drop connections at manholes must be constructed as shown on standard drawings.
- Service connections must be made so the service is perpendicular to the sewer main unless a manufactured wye is installed.
- All service connections must have a minimum slope of ¼ inch per foot toward the main and must have a minimum depth of 4 feet below the finished surface at the connection to the building.
- Place double cleanouts a maximum of 100 feet along the service line. Place single cleanouts at all horizontal bends, and at a minimum distance of 5 feet away from the face of the building. Cleanouts must be constructed in accordance with the standard drawings. Place a double cleanout at a minimum of 5 feet away from the face of the building if there is inadequate cleanout access in the building.

3.4.3 Natural Gas

This subsection describes criteria and standards for the design of natural gas distribution systems. Consult with FMOC Infrastructure Engineering in advance for approval of any departure from the criteria.

The SNL/NM natural gas distribution systems are operated at a nominal pressure of 20 psi. Designs should allow for a future pressure capability of 60 psi. Size components for a local atmospheric pressure of 12.12 psia.

All gas lines and their connections to existing gas lines must be designed and shown on a plan and profile drawing. Drawings must show all details, including required components and fittings. Gas system designs

must meet all applicable codes and requirements. Consult with FMOC Infrastructure Engineering for planning and system modeling of all gas distribution work.

Locate distribution lines in a utility corridor whenever possible.

All pipes and valves are to be high-density polyethylene piping in accordance with the SNL/NM Construction Standard Specifications and Standard Drawings. Butt-fusion connections to existing piping or dissimilar materials are not allowed; these connections must be made with an electro-fusion coupling.

Use an anodeless riser followed by an insulating union in accordance with SNL/NM standard drawings to isolate electrically the above ground and below ground gas systems.

Use of tapping saddles requires approval from FMOC Infrastructure Engineering.

Test ports are required for line spot purposes at all major direction changes or every 200 feet, whichever distance is lesser. If the spanned distance is less than 400 feet, but more than 200 feet, split the distance to allow equal spacing between the test ports. Use marker post test boxes in remote locations.

Size the natural gas main lines based on requirements from FMOC Infrastructure Engineering. Size building feeds according to the design code and service load requirements of the facility. Size the piping past the building regulator in accordance with the latest revisions of NFPA 54, *National Fuel Gas Code.*

Branches off of the main gas line must have a ball valve in a valve box to isolate the building or facility from the gas main.

The minimum depth of cover over all gas lines must be 36 inches. The trench for pipe installation must be in accordance with the manufacturer instructions and recommendations for the pipe installed.

Install the regulator/meter assembly outside of the building in accordance with SNL/NM Standard Drawing WG5007STD. A regulator is required to control the pressure between the gas distribution grid and the gas meter; this regulator must be rated for 60 psi minimum pressure and may be set at pressures up to 15 psi to allow greater utilization of meter capacity. The final regulator before the service feed enters the building must be spring operated with built-in relief protection and an insect screen. Building gas meters must be installed with a minimum pressure rating of 25 psi. Choose the meter type based on required meter capacity using Table 3.3.

The meter should have an odometer type head for reading cumulative gas usage and must be connected to the FCS system or configured with a Mercury Mini Max ATX corrector head for data recording purposes. Regulator/meter assemblies that are configured with a corrector head must also be configured with the required pressure and temperature sensors. Meter selections must be approved by the SNL/NM Gas System Engineer. Obtain approval from the SNL/NM Gas System Engineer and the Fire Protection Engineer to use gas pressure exceeding 14 inches water column inside the building. The regulator/meter assembly must be protected from vehicle damage.

During construction phasing a cap, connected using electro-fusion, must be installed on any open pipe prior to energizing the pipe during phasing activity. New pipelines may not be energized with natural gas while open to the atmosphere. All abandoned pipes left in the ground must be purged with air and plugged or capped.

The design of valves within the gas system must conform to the following criteria:

- At the intersection of gas lines, the distribution lines in all directions must have an in-line valve.
- Valve Location: Avoid locating valves under parking spaces or locations where valves might be inaccessible, in sidewalk ramps, and next to fences.
- Valve Type: Valves must be high-density polyethylene ball valves.
- Valve size: All valves must be the line size full-port valves.

Table 3.3 Meter Selection Based on Required Capacity

	Meter Type		
Required Flow (SCFH)	**Diaphragm**	**Rotary**	**Turbine**
10 – 1000	X		
1,000 – 3,400	X	X	
3,400 – 10,000		X	
10,000 – 26,000		X	X
26,000 – 388,000			X

3.4.4 Liquefied Petroleum Gas

Provide heating energy to areas remote from natural gas distribution using a liquefied petroleum gas system. All installations must meet the requirements of NFPA 58, *Liquefied Petroleum Gas Code*.

Size the tank for 30-day storage for the maximum-degree day and to ensure that the tank will supply adequate cold day gas to meet the demand of the facility it is servicing. Consider the composition of the liquid locally distributed during the winter when sizing the tank.

Locate a regulator, relief valve, capacity gauge, and fill valve under a protective cover on the top of the tank. The exterior regulator must have an automatic shutdown device for excess flow conditions. Select line and regulator size to prevent freeze-up during cold weather usage. Specify an American Gas Association 100-percent shutoff safety pilot and appliance regulator on all appliances.

3.4.5 Storm Drains

Storm drain design must comply with the design portions of chapter 22 of the City of Albuquerque *Development Process Manual* (see Attachments 3.A and 3.B in chapter 12 of this *Design Standards Manual* for a list of approved design guidance, SNL/NM Construction Standard Specifications and Standard Drawings). The technical guidance that applies includes the following sections:

- Hydrology
- Hydraulic Design
- Channel Treatment Selection Guidelines
- Design Grading and Erosion Control
- Miscellaneous

See section 3.6, "Drainage Requirements."

3.5 Site Work

3.5.1 Grading

Prepare a current topographic survey for all construction projects when grading or trenching is required. The topographic survey must be tied into the SNL/NM Survey Control Monuments for establishing x, y, and z (see section 3.7, "Surveying"). Plan the facilities to fit the topography with a minimum of grading and to preserve the site character in an efficient and economical manner. Site grading must minimize site disturbance by emphasizing conservation of existing natural areas and restoration of previously damaged areas.

In the site grading design provide for adequate surface drainage and preservation of natural terrain by allowing a minimum of earth movement with the objective of balancing cut and fill. To prevent surface drainage from entering or ponding adjacent to the structure, place finished floor elevations with access penetrations sufficiently above the existing ground gradient or the roadway grade. Write an accompanying drainage report to prove these criteria (see section 3.6, "Drainage Requirements.")

In the site grading design, take into account the need for safety and ease of personnel and vehicular access to the facility. Accessibility to facilities is required for physically handicapped persons in accordance with the *ABA Accessibility Standard for Federal Facilities* 2006 from the General Services Administration. Bus stops, bus stations, and rail stations are to follow the *ADA Standards for Transportation Facilities* 2006 from the U.S. Department of Transportation.

Design the outside finished grade to slope away from the building at a 5-percent grade for the first 10 feet unless otherwise approved by FMOC Infrastructure Engineering. Extend the 5-percent grade to 20 or 30 feet in areas with highly expansive soil. When site conditions require the use of steep slopes near buildings, provide an area that is at least 6 feet wide at a 5-percent grade away from the building. Indicate these requirements on the grading plan with critical spot elevations and finished contours. When the adjacent outside grade is brought above the building floor level for energy conservation, aesthetic, or economic reasons, design the outside finish grade to slope away from the building at a 20 percent minimum grade for at least 5 feet.

3.5.2 Fencing

Design fencing to provide the intended function, such as safety or security. Security fencing is required as a physical demarcation of a security area, for security of classified assets and government property, and to direct flow of personnel and vehicles through designated entry control points. Fencing must be designed in accordance with SNL/NM Construction Standard Specifications and Standard Drawings. Fire department access must be provided during construction and occupancy phases when designing temporary and permanent fencing.

Fences to be used for security purposes must be at least 8-feet high, with fabric a minimum of 11-gauge galvanized steel, and with mesh openings a maximum of 2 inches on each side. The fence must be topped by a minimum of 3 strands of barbed wire on single or double outriggers. Single outriggers must be angled outward from the security area. Double outriggers must be used at Protected Area boundaries. Security fencing must extend to within 2 inches of firm ground or extend below the surface, if the soil is unstable or subject to erosion.

Alternative security fencing is allowed with approval from Physical Security. Alternative fencing must meet the penetration resistance of the standard chain link security fencing. Drawings and calculations of

penetration resistance for alternative fencing must be submitted for approval to Physical Security prior to contract acceptance.

Posts bracing and other structural members must be located on the inside of security fences. Wire ties must be of equal tensile strength as that of the fabric.

Locate security fencing with a clear zone along each side of the fence to facilitate intrusion detection and prevent bridging over the fence. Fence must be located a minimum of 20 feet from structures or assets located inside the security area and a minimum of 20 feet from structures located outside the security area. Landscaping must be designed such that plant growth does not impede visual assessment or allow bridging. Consult with a Physical Security representative for the latest standoff requirements.

3.5.3 Gates and Turnstiles

Location of turnstiles and motorized gates must be coordinated with FMOC Infrastructure Engineering to ensure adequate automated access control and other system support.

Use swinging gates for access through security fencing. Use swing gates in other fencing when possible. When rolling gates are required, use a system with an overhead support, if practical. If a cantilevered gate must be used, use a system with an enclosed top rail as a track. Avoid using rollers at grade because dust and water accumulations are a constant maintenance problem.

Gate hardware for security fencing must be brazed, peened, or welded to prevent removal.

Use turnstiles for pedestrian entry control points. A minimum of two single turnstiles and one bypass gate must be used at each entry location, unless within line of sight of another entry point. Tandem turnstiles must not be used because of safety and maintenance concerns.

Additional security fencing requirements, including temporary security fencing, are described in chapter 11, "Security Design Standards," of this *Design Standards Manual.*

3.5.4 Sidewalks

Design sidewalks and walk gradients to provide safe and convenient access, egress, and circulation between facilities. Base the width of sidewalks on anticipated traffic, with a minimum width of 6 feet increasing in 2-foot increments. Sidewalks paralleling curbs in parking areas and those with high pedestrian use must have a minimum width of 6 feet of available walking area. All sidewalk widths must be consistent with ADA/ABA accessibility requirements (see subsection 3.5.1, "Grading"). Install ramps where required to maintain accessible routes.

Integrate sidewalk design with drainage system and landscape design as much as possible to promote collection, conveyance, and infiltration of stormwater runoff generated from continuous, impervious sidewalk surfaces. In addition, prevent sidewalks from contributing to heat island effects by providing shade from landscaping or locating sidewalks in areas not subject to sustained sunlight. Refer to the *Campus Design Guidelines* for SNL/NM for more information and requirements on sidewalks and pedestrian path.

3.5.5 Dual Bicycle and Cart Paths

Bicycle and cart paths must be separated from pedestrian sidewalks. The paths must have a minimum width of 12 feet for two-way traffic and 8 feet for one-way traffic, a maximum longitudinal slope of 5%, and a maximum cross slope of 2%. See the *Campus Design Guidelines* for SNL/NM for further information.

3.5.6 Roads

The criteria for road design must be in accordance with AASHTO *A Policy on Geometric Design of Highways and Streets*, latest edition. When designing roads and associated drainage systems, take into account soil, geologic, topographic, and climatic conditions, including any special conditions, such as snow removal. Roadways must be designed to accommodate the maximum size of vehicles traveling through the area. During planning and design, carefully consider the timing of road construction, specifically for seasonal conditions. Flexible pavements and curb and gutter must be in accordance with approved standard drawings.

If required, perform studies to estimate the volume and character of traffic during both the construction and operating phases. Controlling vehicle speed within congested areas can permit the profile of roads to conform generally to the ground surface, which allows maximum use of adjacent areas and results in economical road construction costs. The FMOC Infrastructure Engineering department determines speed limits. Reserve sufficient corridor width for anticipated future expansion. Design and plan underground utilities and their construction to minimize interference with road construction and trench cuts in recently paved areas.

Integrate road design with drainage system and landscape design. Consider landscaping and other suitable means of harvesting runoff from roads to promote collection, conveyance, and infiltration into the soil.

For environmental protection, provide adequate drainage and soil stabilization for roads and construction areas. In addition, carefully maintain roadways, ditches, and drainage structures during construction.

Design of emergency vehicle access must conform to fire lane requirements defined in NFPA® 1141, the International Fire Code® (IFC), and the City of Albuquerque Fire Code, or as might be determined by the SNL Emergency Operations Center.

Table 3.4 indicates the radii of intersections to the back of the curb that must be followed.

Table 3.4 Radii of Intersections to the Back of the Curb

Type of Intersection	Distance
Primary and secondary intersection	50 feet
Entrance drive: • For private vehicles • For large trucks, fire-equipment areas, warehouse and depot areas, and fuel loading and unloading areas	 25 feet 50 feet
Secondary street intersections and other areas	30 feet

3.5.7 Parking

Locate parking areas to blend into the background of the building complex without detracting from the principal structures. Avoid siting parking areas in front of buildings and at prominent visual points of approach. Provide accessible pathways according to *ABA Accessibility Standard for Federal Facilities* 2006 from the General Services Administration. Provide for special parking with space designators and emergency access according to chapter 4, "Landscape Design Standards," of this *Design Standards Manual* and the *Campus Design Guidelines* for SNL/NM. Emphasize attractive features and de-emphasize or obscure undesirable features when designing landscaping, grading, and locations. For parking stall dimensions and other requirements see the *Campus Design Guidelines*.

Parking system design must be integrated with the drainage system design and landscape design. Parking systems should be designed to minimize generation of stormwater runoff, harvest stormwater for landscape irrigation, and prevent the formation of heat islands. Avoid large continuous parking areas that generate stormwater runoff and become heat islands during summer months (see section 3.6, "Drainage Requirements," for more information). Consider smaller connected parking areas separated by landscaping that provides runoff management. Include landscape provisions (in the form of trees) to ensure that at least 30 percent of parking areas are shaded within 5 years of project completion.

Provide perimeter concrete curbs and gutters for all parking areas and access drives in built-up areas. Consider directing runoff to infiltration areas, such as medians or adjacent planting areas. Such water-harvesting areas must be designed and planted to accommodate occasional flooding. Direct the stormwater runoff into the storm drain only when the capacity for onsite management is exceeded. In remote or infrequently used areas, use concrete curbs and gutters only when required to control drainage.

To provide positive surface drainage, design pavement grades with the following:

- 1/2-percent absolute minimum slope in the direction of drainage; use greater slopes wherever possible
- 5-percent maximum slope in all directions for bituminous or concrete surfaces
- 2-percent maximum slope in all directions for handicapped-accessible parking spaces and access aisles

During planning and design, consider the following factors when determining vehicle parking requirements:

- Occupancy of the facility to be served
- Provisions for physically handicapped persons
- Preferred parking for carpools and vanpools
- Service vehicle and visitor parking needs
- Single facility parking areas versus joint-use parking for adjacent facilities
- Aesthetics (siting, landscaping)
- Location of fire-protection devices (hydrants, pumper connections) and accessibility for emergency vehicles
- Facilities for motorcycle and bicycle parking
- Garbage truck access

- Provisions for pedestrian traffic. Orientation of the parking rows should promote pedestrian travel in a manner that minimizes the need for pedestrians to cross through other parking rows to obtain access to pedestrians paths. Provide identifiable pedestrian routes parallel to vehicular traffic within the parking lot. Provide designated pedestrians paths at key points across rows when necessary to move pedestrians towards pedestrian paths leading from the parking area.
- Provide painted parking stalls to the dimensions indicated in the *Campus Design Guidelines*. Avoid the use of parking bumpers.
- Pedestrian walkways may also serve as curb stops. Concrete sidewalk must be 6 inches above parking lot grade, and must be of sufficient width to convey the anticipated number of pedestrians and provide for vehicle overhang with a minimum of 6 feet of available walking area.
- Appropriate distance from perimeter fencing (see chapter 11, "Security Design Standards.")

3.5.8 Landscaping

Provide landscaping according to the *Campus Design Guidelines* for SNL/NM and chapter 4, "Landscape Design Standards," of this *Design Standards Manual*. Landscape development should enhance the overall exterior appearance of buildings while emphasizing low water usage, minimal maintenance, and native plant materials.

When choosing and locating species of trees, ensure, as much as possible, that they do not damage underground utility lines and adjacent surface facilities. Place landscaping so it does not interfere with maintenance and repair efforts.

Consider landscaping when designing energy-conservation solutions. Proper landscaping benefits include reducing solar radiation during cooling season, heat loss from wind, and heat loss during heating season. Use landscaping to provide shading on buildings, parking lots, roadways, walkways, and other heat-absorbing surfaces that can act as heat islands during summer months. Consider deciduous plant species near buildings that provide shading during summer months and allow solar heat gain during winter months.

Consider landscaping when developing drainage system designs. Integrate landscaping with stormwater management to maximize onsite containment, conveyance, and infiltration of stormwater runoff. Use landscaping to minimize the generation of stormwater runoff and control erosion. Incorporate rainwater harvesting to replace (if possible) or supplement landscape irrigation requirements. Use high-efficiency irrigation systems for landscapes (drip systems, moisture sensors, weather database controllers). Landscaping should be included when designing parking lots, roadways, and other surfaces that generate stormwater runoff. See section 3.6, "Drainage Requirements," for more information.

3.5.9 Removal of Utilities

Apply the following guidance when removing utilities from service or encountering abandoned utilities:

- If an entire site is being cleared, remove the utility within the entire confines to be cleared. If the utility extends beyond that confine and crosses sidewalks and roadways, remove the portions inside the site and abandon in place those portions offsite.
- If a roadway or sidewalk is cut open for construction work and an abandoned utility is exposed (or abandoned by that project), remove exposed portions.
- If roadways or sidewalks that would otherwise not be cut would be cut to remove, then abandon in place.

- Check the system configuration to see if there are advantages or disadvantages to either removal or abandonment. For example, if there is a short piece of steel gas pipe that could either be removed or abandoned, check to see if maintenance of cathodic protection on this section could be eliminated by taking out this short additional piece.
- Minimize surface disturbance to the extent practical and ensure protection of adjacent natural or landscaped areas.
- Remove all abandoned valves, and cap the mains or the service laterals at the fitting in the main.

3.6 Drainage Requirements

3.6.1 General Drainage Requirements

Section 3.6 of this *Design Standards Manual* applies only to SNL/NM with one exception—subsection 3.6.2, "Energy Independence and Security Act Requirements," applies to both the New Mexico and California (SNL/CA) sites.

A drainage plan is required for all development or redevelopment projects at SNL that must implement the stormwater runoff requirements of section 438 of the Energy Independence and Security Act (EISA) as further explained in subsection 3.6.2 of this *Design Standards Manual*. A drainage plan is also required for any project that has drainage improvements unless an exception is provided by FMOC Infrastructure Engineering. Design engineer is to consult with FMOC Infrastructure Engineering during the conceptual phase for drainage requirements. Some master drainage plan information for Technical Areas I, II, III, IV, and V is available for review upon request.

Design the drainage system layout to best meet the operational requirements of the facility and the requirements in this section. Design all new storm drain systems to convey a 100-year, 6-hour storm. The system should be economical and efficient while considering the following:

- EISA requirements (3.6.2)
- Flooding protection requirements (3.6.3)
- Topography
- Ultimate development of the drainage area
- Outfall locations
- Downstream capacities and effects on surrounding facilities
- Coordination with underground utilities
- National Pollutant Discharge Elimination System (3.6.4)
- Hydrology (3.6.5)
- Hydraulics (3.6.6)

Where applicable, drainage system design should promote infiltration into the soil by incorporating provisions for onsite collection, conveyance, and containment in coordination with the EISA requirements in subsection 3.6.2. Consider integration of the drainage system design with other aspects of the facility design to limit the disruption of natural water flows by minimizing the generation of stormwater runoff, increasing onsite containment and infiltration of stormwater into the soil, and reducing contamination in stormwater that must be conveyed offsite. Drainage system design-integration measures that should be considered include, but are not limited to, the following:

- Roof drainage: Incorporate roof drainage into the overall drainage system design. Refrain from integrating the roof system directly with the storm drain unless no other onsite containment method is feasible (see subsection 6.3.3.8).
- Landscaping: Incorporate landscaping features that collect, convey, contain, and promote infiltration of stormwater into the soil. Include rainwater harvesting (use of stormwater) in the irrigation design for landscaping when practical (see subsection 3.5.8).
- Parking, roadway, and sidewalk: Minimize impervious surfaces that generate stormwater runoff. Minimize the use of storm drain inlets, except to accommodate overflow from onsite containment capacity. Consider separating parking rows with landscaping that can collect, convey, contain, and infiltrate runoff into the soil (see subsection 3.5.7).

3.6.2 Energy Independence and Security Act Requirements

This subsection, relating to the EISA, applies to both SNL/NM and SNL/CA.

All development projects or redevelopment projects at SNL with a footprint that exceeds 5,000 square feet must implement the stormwater runoff requirements of EISA section 438 by following the guidance provided in the U.S. Environmental Protection Agency (EPA) document *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under section 438 of the Energy Independence and Security Act* (referred to as "EPA Guidance") dated December 4, 2009. This document is available from the EPA web site.

Section C on pages 9-11 of the EPA Guidance describes applicability and definitions because "footprint" in EPA terms does not mean just the building. While you must read all of the EPA Guidance to apply it correctly, section C of the EPA Guidance described above is reprinted here in italic text:

C. Applicability and Definitions

Applicability

1. Who is a "Sponsor" of a project?

Section 438 applies to the "sponsor of any development or redevelopment project involving a Federal facility . . ." Section 438 requires that the "sponsor . . . shall use . . . strategies for the property to maintain or restore . . . the predevelopment hydrology. . ." The "sponsor" should generally be regarded as the federal department or agency that owns, operates, occupies or is the primary user of the facility and has initiated the development or redevelopment project. If the federal agency hires another entity to perform activities such as site construction or maintenance, the agency should nonetheless be regarded as the sponsor and be responsible to assure compliance with the requirements of Section 438. The agency sponsor is free to contract out various duties and responsibilities that are associated with achieving compliance.

2. What is a "Federal facility"?

Section 438 provides that its requirements apply to the "sponsor of any development or redevelopment project involving a Federal facility . . ." Section 401(8) of EISA states: "The term `Federal facility' means any building that is constructed, renovated, leased, or purchased in part or in whole for use by the Federal Government."

3. What is a "footprint"?

Section 438 applies to a federal facility "with a footprint that exceeds 5,000 square feet." For the purposes of this guidance, any project involving a federal facility that disturbs 5,000 square feet or more of ground area is covered by this guidance. Existing facilities that have an overall footprint of 5,000 square feet or greater that disturb less than 5,000 square feet of land area as part of any single development or redevelopment project are not subject to Section 438 requirements. Consistent with the purpose of Section 438 to preserve or restore pre-development hydrology, the term "footprint" includes all land areas that are disturbed as part of the project.

4. What is "the property"?

Section 438 provides that the project sponsor "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." This clause has been interpreted to mean that the land surrounding the project site is available to implement the appropriate GI/LID practices where optimal.

Although the performance requirements of EISA Section 438 apply only to the project footprint, the flexibility exists to use the entire federal property in implementing the stormwater strategies for the project.

Definitions

95th percentile rainfall event. The 95th percentile rainfall event represents a precipitation amount which 95 percent of all rainfall events for the period of record do not exceed. In more technical terms, the 95th percentile rainfall event is defined as the measured precipitation depth accumulated over a 24-hour period for the period of record that ranks as the 95th percentile rainfall depth based on the range of all daily event occurrences during this period.

The 24-hour period is typically defined as 12:00:00 a.m. to 11:59:59 p.m. In general, at least a 20-30 year period of rainfall record is recommended for such an analysis. This raw data is readily available and collected by most airports across the county. Small rainfall events that are 0.1 of an inch or less are excluded from the percentile analysis because this rainfall generally does not result in any measureable runoff due to absorption, interception and evaporation by permeable, impermeable and vegetated surfaces. Many stormwater modelers and hydrologists typically exclude rainfall events that are 0.1 inch or less from calculations of rainfall events of any storm from their modeling analyses of rainfall event frequencies. See, for example, the Center for Watershed Protection's Urban Subwatershed Restoration Manual 3 (available at www.cwp.org).

Federal facility. The term "federal facility" means any buildings that are constructed, renovated, leased, or purchased in part or in whole for use by the federal government as defined in section 401(8) of the Energy Independence and Security Act.

Development or re-development. For the purposes of this provision this term applies to any action that results in the alteration of the landscape during construction of buildings or other infrastructure such as parking lots, roads, etc. (e.g., grading, removal of vegetation, soil compaction, etc.) such that the changes affect runoff volumes, rates, temperature, and duration of flow. Examples of projects that would fall under "re-development" include structures or other infrastructure that are being reconstructed or replaced and the landscape is altered. Typical patching or resurfacing of parking lots or other travel areas would not fall under this requirement.

Based on the EPA Guidance above, FMOC Infrastructure Engineering offers some general clarifying interpretations:

- Site: The term "site" is defined to be the area of the development or redevelopment, such as a building and its developed surroundings. This should not be confused with the SNL New Mexico site or California site. The New Mexico and California sites are actually made up of many individually developed sites.
- Laydown Yards: Laydown yards contiguous to the project footprint that disturb the land to such a level that it must be restored upon completion of the project are to be considered part of the project footprint. Laydown yards contiguous to the project footprint that do not disturb the land to such a level that restoration is required at the end of the project are not considered part of the project footprint. Laydown yards that are not contiguous to the project footprint are considered on a case-by-case basis.
- Roadways and Parking Lots: General maintenance including, but not limited to, overlays, crack sealing, slurry sealing, pothole repair, and striping are not subject to the EPA Guidance. Typical patching or resurfacing of parking lots or other travel areas would not be subject to the EPA Guidance. Roadway or parking lot projects involving reconstruction of an existing roadway or parking lot, renovation of an existing roadway or parking lot, or construction of a new roadway or parking lot are assessed on a case-by-case basis using EPA Guidance definitions.
- Existing Building Renovations: Existing building renovations where the renovation takes place wholly within the confines of the walls of an existing building are not considered part of the 5,000 square-foot project footprint limit. This is because work on top of concrete slab flooring in a building is interpreted to not disturb land. Laydown yards and external site work would be considered separately.

Examples of projects that must follow the EPA Guidance for the handling of runoff are as follows:

- New building of 7,000 square feet with 10,000 square feet of disturbed area around the new building in site development and landscaping. Total disturbed: 17,000 square feet.
- New building of 3,000 square feet with 1,000 square feet of disturbed area around the new building at the foundations and 2,000 square feet of a contiguous laydown yard that requires restoration. Total disturbed: 6,000 square feet.
- Building addition of 6,000 square feet onto an existing building of any size with 200 square feet of disturbed area around the new building in site development. Total disturbed: 6,200 square feet.
- Building renovation of 10,000 square feet wholly contained within the existing walls of the building with 6,000 square feet of disturbed area around the building in site renovation. Total disturbed: 6,000 square feet.
- Complete parking lot renovation of 10,000 square feet. Renovation includes removal and replacement of pavement, minor or major regrading, and landscaping. Total disturbed: 10,000 square feet.
- New electrical substation of 6,000 square feet including minor substation access. Total disturbed: 6,000 square feet.

Examples of projects that do **not** need to follow the EPA Guidance for the handling of runoff are as follows:

- New building of 2,000 square feet with 2,000 square feet of disturbed area around the new building in site development and landscaping. Total disturbed: 4,000 square feet.

- New building of 4,700 square feet with 200 square feet of disturbed area around the new building at the foundations. Total disturbed: 4,900 square feet.
- Building addition of 3,000 square feet onto an existing building of any size with 200 square feet of disturbed area around the new building in site development. Total disturbed area: 3,200 square feet.
- Complete parking lot overlay, crack seal, slurry seal, or any general maintenance of any size.
- New electrical substation of 2,000 square feet including minor substation access.

3.6.2.1 EISA EPA Guidance Options

The EPA Guidance provides two options for handling runoff. Option 1 is the preferred option for new developments and for retrofitting existing facilities when required. Option 1 stipulates the retention of the runoff from a 95th Percentile Storm on the development site. The 95th Percentile Storm for the SNL/NM site is 1.00 inches. This calculation was per the EPA Guidance and was based upon 20 years of rainfall data from the Photovoltaics rain gauge. The 95th Percentile Storm for the SNL/CA site is 1.06 inches. This calculation was per the EPA Guidance and was based upon 30 years of rainfall data from the Livermore Municipal Airport rain gauge.

In some cases Option 2 is a more reasonable approach to meeting the EPA Guidance. Option 2 may be used in lieu of Option 1 with the approval of FMOC Infrastructure Engineering. Option 2 requires calculation of the predevelopment runoff, calculation of the postdevelopment runoff, and retainment of the runoff volume difference. However, note that Option 2 predevelopment means before development of any kind or what the ground cover would have been in the natural state for that particular area. The frequency storm (or rainfall depth/intensity) to use for these calculations is the closest frequency (such as 1 year, 2 years, or 5 years) at which no runoff leaves the site in the predevelopment condition. The duration storm to use is the time of concentration.

The amount retained under both options is based on the development site and not the overall contributing drainage area. In many cases drainage areas can be much larger than the development site. In these cases, the amount retained is calculated based on the development site only; however, the design of the site still needs design for the offsite flows to pass through the development site. This situation can mean that offsite flows pass through the development site's primary retention system and then overflow or it can mean that the offsite flows pass around and through the development site in a separate system.

In some cases it is not feasible to route the runoff from the edges of a development site through a retention system. For example, it might not be feasible to route the runoff from a roadway edge sidewalk over to a site retention system. In those cases, the edge area is part of the calculations for sizing of the retention system even though the water does not route through it.

New Mexico state water law does not allow retention in excess of that calculated under Options 1 or 2 for projects at the SNL/NM site without approval from FMOC Infrastructure Engineering.

3.6.2.2 EISA Existing Facilities Versus New Developments

In some cases an existing facility is retrofitted to meet EPA Guidance. In those cases, there is only one difference between existing facilities and new developments that needs clarification—the development site boundary. The development site boundary for existing facilities is to be the logical surrounding developed area used in support of the existing facility. Edges of adjacent roadways, fences, and sidewalks may all be used as existing development site boundary demarcations. When there are no easily determined demarcations, use the following:

- Edge of existing developed area
- Half the distance to an adjacent existing building or development

An existing parking area dedicated to a particular existing facility is considered part of the existing development site. An existing roadway that travels past the existing facility and serves many existing facilities is not considered part of the existing development site.

3.6.2.3 EISA Maximum Extent Technically Feasible

Section 438 of EISA and EPA Guidance state that stormwater management efforts are to be executed to the "maximum extent technically feasible." This can have a far-reaching meaning if left unclear. For the SNL New Mexico and California sites, retention of water is not technically feasible in the following circumstances:

- Utilities are under the areas available for retention
- The retention area would cause a loss of use of a mission function
- The retention area would create a safety hazard
- Other circumstances unforeseen currently, but evaluated case-by-case

In cases where retention of the entire amount required is not technically feasible, as much stormwater as possible is to be retained.

3.6.2.4 EISA Retention Design Notes

Many retention methods can be applied. The following are meant as guides, not an exhaustive list:

- Each development or redevelopment site should meet these *SNL Design Manual* requirements on its own site. There is no current plan for centralized retention or to use a retention banking system with a centralized retention location.
- Each retention area must retain the required runoff in a safe, stabilized from erosion, and, where possible, multipurpose manner.
- Each retention area must provide overflow with staged release to mimic, in a simple and general manner, the natural flow rates in excess of that retained.
- Where possible, retention areas should be an integral part of the landscaping. Avoid large deep holes for retention. The retention areas used as part of the landscaping can be shallow and can be used to water the surrounding plants by flood irrigating.
- Although permeable pavements can be useful, it is not a preferred method for reducing runoff because of the high maintenance required from needed periodic vacuuming. It is also not preferred because of the increased possibility of slips, trips, and falls from rough pavement surfaces. Permeable pavement is not to be used on roadways.
- Underground storage is not a preferred method because of the large number of existing utilities, the high associated maintenance costs, and the fact that problems can be hidden from view.
- Each retention area must also be placed sufficiently away from a structure that no adverse effects on the structure occur. Because this distance can vary from one development site to another, the Geotechnical Engineer responsible for the structure determines what that distance is with approval of the FMOC Engineer responsible for stormwater.

- The volume of runoff that is captured from structure roofs and held for use is to be included in the total volume retained for the development site.

3.6.2.5 EISA Documentation

Provide documentation showing adherence to the EPA Guidance as part of the drainage plan for the particular site or project. Include the form FRM.206, *Design Standards Manual Documentation Checklist Showing Adherence to EPA Guidance,* in the drainage plan for the particular project. This form is available from the FMOC web site in the Forms Locator.

3.6.3 Flooding Protection Requirements

All facilities are to be protected from flooding according to the Department of Energy Standard DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, and all updates; a section of the standard is dedicated to flooding hazards. Finished floor elevations and other applicable facility elements are to be set or designed consistent with the requirements of the standard. Finished floor elevations are to be approved by FMOC Infrastructure Engineering. The flood protection requirements in the standard are based upon the Performance Category of the facility being designed. That Performance Category is to be obtained from the SNL Project Lead. As a reference, Performance Category 1 facilities are the least restrictive and are required to be protected from a 500-year-frequency storm event.

Flooding effects on existing adjacent and downstream facilities that are a result of the facility being designed are to be considered during the design process. Any increased flooding effects on existing adjacent and downstream facilities that are a result of the facility being designed are to be mitigated as part of the design and construction process. Mitigation is required if the existing adjacent and downstream facilities no longer meet the requirements of the standard or if the increase in the flooding effects reduces the functionality of the existing adjacent and downstream facilities.

The design must meet the requirements of the City of Albuquerque's *Development Process Manual* (DPM), section 22, "Drainage, Flood Control and Erosion Control." Whenever a conflict exists between the DPM and the standard, the more stringent of the two requirements applies. See subsection 6.3.3.8, "Drainage," of this *Design Standards Manual* for all roof-drainage design requirements.

3.6.4 National Pollutant Discharge Elimination System Permitting

All construction sites that disturb an area of one acre or more are subject to National Pollutant Discharge Elimination System (NPDES) permitting requirements. Specifically, most construction projects fall under the jurisdiction of the most recent edition of the NPDES General Permit for Stormwater Discharges from Construction Activities. The permit is titled *National Pollutant Discharge Elimination System General Permit for Discharges from Large and Small Construction Activities*. To determine the applicability of NPDES permitting requirements, the disturbed area associated with a construction site is defined as follows: "The physical location of the new facility with any utility extensions, haul roads, stockpile areas, staging areas, and any additional area disturbed by the construction."

The NPDES permit requires development of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must meet the applicable requirements of the *National Pollutant Discharge Elimination System General Permit for Discharges from Large and Small Construction Activities*, including requirements listed in Part 3, "Storm Water Pollution Prevention Plans," and Part 8, "Standard Permit Conditions."

Additionally, Part 8, "Standard Permit Conditions," requires that a Sediment Control Plan (SCP) be developed and certified by a licensed Professional Engineer as part of the SWPPP. Review Part 8, "Standard Permit Conditions," C, Region 6 of the General Permit, for additional guidance and requirements. Determination of soil erosion and sediment control measures included in SWPPP are based on the nature of the construction activities and the characteristics of the construction site.

The SCP must include site-specific interim and permanent stabilization, managerial and structural solids, erosion- and sediment-control BMPs and other controls designed to prevent an increase in the sediment yield and flow velocity from preconstruction, undisturbed conditions. Erosion control techniques for interim stabilization may include silt fencing, bale barriers, earthen berms, swales with appropriate BMP at point of discharge, sediment ponds, stabilized entrances to the construction site; or other acceptable erosion control practices. Erosion control practices for permanent stabilization might include reseeding, final site grading, and permanent surface stabilization, such as paved surfaces, landscaping treatments, and graveled areas or other engineered solutions appropriate for permanent stabilization.

Small construction sites of one to five acres may be eligible for a waiver, if the requirements in NPDES permit Appendix D, "Small Construction Waivers and Instructions," can be met. Additional guidance related to NPDES permitting requirements can be found at the following web address: http://cfpub.epa.gov/npdes/stormwater/cgp.cfm

Develop the SWPPP and the SCP based on the requirements of the NPDES General Permit, and submit the documents to the SNL Project Lead for review and approval during the design phase of a project, or must determine if SNL is eligible for a waiver. The SNL PL must submit the final SWPPP to the Environmental Programs and Assurance (4143) for review and coordination of final approval. Upon review and final approval of the SWPPP document 4143 coordinates the submittal of a Notice of Intent (NOI) to the Environmental Protection Agency. Both SNL and the construction contractor are required to submit NOIs. The permit does not become effective until seven days after the EPA posts the NOI on its web site.

Once the construction contract has been awarded, the contractor must adopt the SWPPP and SCP developed for the project as required. The contractor may elect to provide its own SWPPP and SCP, but this action must be approved by SNL, and the contractors' SWPPP must be developed to the same standard as the SWPPP developed for SNL/NM. Construction work must not commence prior to meeting all of the NPDES permit requirements. Further guidance on development of SWPPPs and SCPs can be obtained from the SNL PL or FMOC Infrastructure Engineering, as well as the EPA web site.

3.6.5 Hydrology

The hydrology criteria used must comply with the City of Albuquerque's DPM, section 22, "Drainage, Flood Control and Erosion Control." For the precipitation depth for a 500-year event, use the DPM's precipitation depth for a 100-year event multiplied by 1.28. Use the Precipitation Frequency Data Server found at the National Weather Service's Hydrometeorological Design Studies Center for establishing design frequencies for the DBFL that are not available through the DPM or this manual. For Technical Areas I, II, and IV, use the latitude and longitude for anywhere in Technical Area I in the Precipitation Frequency Data Server when needed; that is close enough. For other Technical Areas, use an approximate latitude and longitude for those locations. For example, a latitude and longitude for anywhere in Technical Area III may be used for any work within Technical Area III, Technical Area V, or the Coyote Test Field. Again, that is close enough.

3.6.6 Hydraulic Design of Closed Conduits and Open Channels

Design all storm-drainage systems per section 3, "Hydraulic Design," in chapter 22 of the City of Albuquerque's DPM. Storm-drainage systems include streets, storm drains, and open channels (borrow ditches, earth channels and armored channels). See subsection 3.6.1 of this chapter of the *Design Standards Manual* for the design frequency and design storm requirements.

Show the flow (Q), velocity (V), hydraulic grade line (HGL), and, upon request, the energy grade line (EGL) on the construction drawings for all storm-drainage systems. Keep this information on the construction drawings, and file it with the construction set for reference.

3.6.6.1 Closed-Conduit Systems

Design closed-conduit systems (including pipe, box, or arch sections) as flowing full and, whenever possible, under pressure, unless otherwise approved by FMOC Infrastructure Engineering. When designing a proposed conduit for pressure condition, do not allow the hydraulic grade line to be higher than the ground or street surface at the design flow. Typically design lateral pipes entering a main line pipe storm drain to use standard precast wye fittings.

The minimum diameter of the main-line conduit must be 18 inches. The minimum slope for the main-line conduit must be 0.005 feet per foot, and the minimum flow velocity must be 3 feet per second during conveyance of the design flow. If warranted by existing circumstances, the main-line slope may be flatter than 0.005 feet per foot if approved by FMOC Infrastructure Engineering.

3.6.6.2 Open-Channel Systems

Construct open channels only in locations approved by the FMOC System Engineer responsible for storm drains. In general, to allow for the interception of surface flows, design all open channels with the tops of the walls or levees at or below the adjacent ground. For unlined open channels, the mean velocity must not exceed 3 feet per second. Determine maximum side slopes for the channel based on an accompanying soils report. In general, the side slopes should not exceed 3:1 (H:V).

When a storm drain outlets into a natural channel or unlined channel, provide an outlet structure to prevent erosion. The minimum requirements are a headwall and appropriate riprap including a wire-enclosed riprap blanket; however, the actual design should be based on the flow and velocities in accordance with the most recent version of the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) *Sediment and Erosion Design Guide*.

3.6.6.3 3Street Drainage

Street drainage is usually accomplished by the use of curbs, gutters, and curb inlets. Consider curb gaps in areas where roadside ditches are used. As a general rule, the streets should be clear during a 10-year storm and checked for adequate capacity during larger storms up to and including a 100-year event as defined in the City of Albuquerque DPM. Do not use inverted crown sections for streets without prior approval. Do not locate curb inlets in the radii of street intersections or where pedestrian traffic is most likely to occur.

3.7 Surveying

This section defines the types of surveying and established minimum requirements governing the performance of survey-related services by Registered Professional Surveyors performing work for SNL/NM.

The survey must be established in the New Mexico State Plane Central Zone (NAD 83) Coordinate System (NAVD 88) vertical datum. Surveys must be coordinated through FMOC Infrastructure Engineering. Surveying control data may be obtained from the FMOC Infrastructure Engineering department. The accuracy of the survey for construction, control, property, and topographic surveys must be consistent with importance of each survey. Where required by law (that is, applicable state statutes) control and property surveys at SNL/NM must be performed by, or under the direct supervision of a Professional Land Surveyor registered in the State of New Mexico. All survey mapping files must be submitted in Bentley MicroStation format (*.dgn) and be in accordance with the requirements outlined in the *CADD Standards Manual*, chapter 7.

3.7.1 Topographic Surveys

Topographic or design surveys must indicate the horizontal and vertical locations of **all surface features**. Underground utilities must be shown in their horizontal location. Sanitary sewer manholes and storm drain inlets and manholes must include vertical data based on measurements from the rim or grate to inverts of pipes. The locations of valve boxes, fire hydrants, post indicators, and other appurtenances for water, heating, and cooling lines must be shown, as well as power poles and clearance at sag of overhead utility lines. Underground communication lines, power lines, and other appurtenances must be indicated. Provide all applicable information on the construction drawings.

Surveys must be coordinated with the SNL/NM Utility Coordinator to assure that underground utility lines are clearly spotted on the ground prior to commencing the survey. Line spots performed by SNL/NM must be in accordance with accepted standards for the color coding of utilities. Survey personnel must be familiar with these standards and reflect the appropriate utility based on the color coding.

> **NOTE** **Pavement cuts must not be used as an indicator of an underground utility location.**

Contour intervals must be 1 foot unless otherwise specified. Sufficient spot elevations must be provided to assure that drainage patterns are evident. The vertical accuracy of 90 percent of the points tested must be within one half of the contour interval, unless otherwise stated on the survey. An American Standard Code for Information Interchange (ASCII) text (.txt) file must accompany all surveys and must be in the following format:

Pt.# Northing Easting Elevation Descriptor (use single spacing between fields)

3.7.2 Monuments

Monuments set by the surveyor must be ferrous metal, at least 0.5 inches in diameter and at least 16 inches long. They must bear a metal or plastic cap stamped with the surveyor's registration number. Control monuments at SNL/NM must be set in accordance with accepted standard drawings (see Attachment 3.B in chapter 12 of this *Design Standards Manual*) for installation of brass caps. The

surveyor must submit a completed Monument of Record form for each monument established. The form can be obtained from Infrastructure Engineering.

Corners that fall upon a hard surface must be monumented with a chiseled cross or a nail in a disk or tag bearing the surveyor's registration number.

When a corner is located at a place where it is not practical to set a monument or a monument is likely to be destroyed, at least one reference monument must be set and dimensioned on the plat such that the location can be reestablished.

The surveyor must perpetuate monuments established by the Public Land Surveying System found in need of rehabilitation or replacement. A description of the monument as found and as restored or referenced and all available dimensions to other monuments must be reported on a recorded plat. Said plat depicting only the rehabilitated or replaced monument satisfies the requirements of this subsection.

3.7.3 Additional Information and Requirements

See Attachment 3.C in chapter 12 of this *Design Standards Manual* for additional information. The attachment contains definitions of the general types of surveying and the minimum criteria that apply at SNL/NM. The types of surveying covered in the attachment are as follows: Boundary Surveying, Topographic Surveying, Easement Surveying, and Unclassified Surveying

- End of Chapter -