

SECTION 31 2000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.
- B. Comply with most current edition of the Northwestern University Design Standards.

1.2 SUMMARY

- A. Provide all labor, materials and equipment as necessary to complete all work as indicated on the Drawings and specified herein.
- B. This Section includes :
  - 1. Excavating and filling for rough grading the Site.
  - 2. Preparing subgrades for walks, pavements, turf and grasses and plants.
  - 3. Subbase course for concrete walks and pavements.
  - 4. Subbase course and base course for paving.
  - 5. Subsurface drainage backfill for walls and trenches.
  - 6. Excavating and backfilling trenches for utilities and pits for buried utility structures.
- C. Related sections include the following:
  - 1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
  - 2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
  - 3. Section 329200 "Turf and Native/Adaptive Plantings" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
  - 4. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices or changes in the Work.
  - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.
- I. Structures: Modular Block Retaining walls, slabs on-grade (excluding building), tanks, curbs, sewerage, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
  - 1. Geotextiles.
  - 2. Controlled low-strength material, including design mixture.
  - 3. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
  - 1. Warning Tape: 12 inches long; of each color.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D 2487.
  - 2. Laboratory compaction curve according to ASTM D 1557.
- C. Blasting plan; No blasting will be permitted.
- D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Contractor shall be responsible for contacting the Owner's Geotechnical Testing Agency at those times required by the specifications for the appropriate materials and soils testing.
- B. Contractor shall coordinate with the Owner's Geotechnical Testing Agency as to the Testing Agency's requirements for advance notification, but allow for a minimum 24-hour notification.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Contractor shall not interrupt utilities serving facilities occupied by the Owner of others unless permitted in writing by NU and then only after arranging to provide temporary utility services according to requirements indicated.
  - 1. Notify NU not less than fourteen (14) days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without NU's written permission.
  - 3. Contractor shall contact utility-locator service (J.U.L.I.E.) for area where Project is located before excavating. A private utility locating service may be required for non-public utilities.
  - 4. Contractor shall demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- C. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Architect.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified on plans are in place.

- E. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- H. Dewatering: Review requirements for dewatering with NU during the design phase. Discharge from dewatering operations must meet with local and State National Pollutant Discharge Elimination System (NPDES) requirements.
- I. Explosives: Do not use explosives.

## PART 2 - PRODUCTS

### A. MATERIALS

- 1. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
  - 2. Satisfactory Soils: Soil Classification Groups GW, GP, GM, GC, SW, SP, ML, CL and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
  - 3. Unsatisfactory Soils: Soil Classification Groups OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
    - a. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; less than 3 percent stones 3/4-inch or larger in any dimension and roots, plants, sod, clay lumps, and other extraneous materials harmful to plant growth.
- 1. Where possible try to match NU sandy loam soil conditions with topsoil re-use or importing similar soil structure.
  - 2. Topsoil shall be free of all deleterious material that may adversely affect the use of the planted surface including any metal, wood, plastic, glass or other manmade materials not intended specifically as a soil supplement.
  - 3. Topsoil shall be free of obnoxious weeds and invasive plants or other undesirable organisms and disease-causing plant pathogens. Topsoil shall be free of chemicals and pesticides, farm crop seeds, with documentation on topsoil origin and soil testing.
  - 4. Topsoil particle sizes shall fall in the following ranges as percentages by mass both separately and in combination:

- a. Clay: 35 percent to 60 percent
  - b. Silt: 35 percent to 60 percent
  - c. Sand: less than 60 percent
  - d. Silt and Clay in combination: less than 65 percent
- C. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Supplement with imported topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 6 inches deep; do not obtain from bogs or marshes.
- D. Topsoil Testing: Include specification to cover testing of topsoil (both from NU and from offsite) and remediation of topsoil.
- E. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone; ASTM D 2940; conforming to State of Illinois, Dept of Transportation Gradation CA-6 or CA-10.
- F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone ASTM D 2940; conforming to State of Illinois, Dept of Transportation Gradation CA-6.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone; ASTM D 2940; conforming to State of Illinois, Dept of Transportation Gradation CA-6 or CA-7.
- H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; conforming to State of Illinois, Dept of Transportation Gradation CA-11.
- I. Drainage Fill: Narrowly graded mixture of washed crushed stone, or washed crushed or uncrushed gravel; ASTM D 448; coarse-aggregate conforming to State of Illinois, Dept of Transportation Gradation CA-14.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- K. Sand: ASTM C 33/C 33M; fine aggregate.
- L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- M. Geotextiles:
1. General: Limit use of geo-textiles. Past experience and over-use has prevented adequate water/rainfall for plant absorption, created surface water collection and "ponding", and prevented optimal sub-surface drainage.
  2. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
    - a. Survivability: Class 2; AASHTO M 288.
    - b. Grab Tensile Strength: 248 lbf; ASTM D 4632.

- c. Sewn Seam Strength: 223 lbf; ASTM D 4632.
  - d. Tear Strength: 90 lbf; ASTM D 4533.
  - e. Puncture Strength: 90 lbf; ASTM D 4833.
  - f. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
  - g. Water Flow Rate: 110 gpm minimum; ASTM D 4491
  - h. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  - i. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
3. Separation Geotextile: Nonwoven needle punched geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
- a. Survivability: Class 1; AASHTO M 288.
  - b. Grab Tensile Strength: 315 lbf; ASTM D 4632.
  - c. Sewn Seam Strength: 284 lbf; ASTM D 4632.
  - d. Tear Strength: 113 lbf; ASTM D 4533.
  - e. Puncture Strength: 113 lbf; ASTM D 4833.
  - f. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
  - g. Water Flow Rate: 110 gpm minimum; ASTM D 4491
  - h. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  - i. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- N. Controlled Low-Strength Material:
1. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
    - a. Portland Cement: ASTM C 150, Type I.
    - b. Fly Ash: ASTM C 618, Class C or F.
    - c. Normal-Weight Aggregate: ASTM C 33/C 33M, 3/8-inch nominal maximum aggregate size.
    - d. Fine Aggregate: Sand IDOT Gradation FA-1 or FA-2.
    - e. Foaming Agent: ASTM C 869.
    - f. Water: ASTM C 94/C 94M.
    - g. Air-Entraining Admixture: ASTM C 260.
    - h. Compressive Strength: Minimum 30 psi at 28 days and 150 psi at 180 days when tested according to ASTM C 495.
- O. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 4 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
  2. Yellow: Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water systems.
  5. Green: Sewer systems.

PART 3 - EXECUTION

A. PREPARATION

1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
2. Protect and maintain erosion and sedimentation controls during earth-moving operations.
3. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

B. DEWATERING

1. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
2. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - a. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

C. EXPLOSIVES

1. Explosives: Do not use explosives.

D. EXCAVATION, GENERAL

1. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - a. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
  - b. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
    - 1) 24 inches outside of concrete forms other than at footings.
    - 2) 12 inches outside of concrete forms at footings.
    - 3) 6 inches outside of minimum required dimensions of concrete cast against grade.
    - 4) Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    - 5) 6 inches beneath bottom of concrete slabs-on-grade.
    - 6) 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.
2. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

- a. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
  - 1) Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
- b. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
  - 1) 24 inches outside of concrete forms other than at footings.
  - 2) 12 inches outside of concrete forms at footings.
  - 3) 6 inches outside of minimum required dimensions of concrete cast against grade.
  - 4) Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
  - 5) 6 inches beneath bottom of concrete slabs-on-grade.
  - 6) 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

#### E. EXCAVATION FOR WALKS AND PAVEMENTS

1. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

#### F. EXCAVATION FOR UTILITY TRENCHES

1. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - a. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
2. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
  - a. Clearance: 12 inches each side of pipe or conduit or as indicated on the plans.
3. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - a. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
  - c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
  - d. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.



4. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
  - a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
5. Trenches in Tree- and Plant-Protection Zones:
  - a. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - b. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
  - c. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

#### G. SUBGRADE INSPECTION

1. Notify Architect when excavations have reached required subgrade.
2. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
3. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - a. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
  - b. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
4. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

#### H. UNAUTHORIZED EXCAVATION

1. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
  - a. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

#### I. STORAGE OF SOIL MATERIALS

1. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - a. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

## J. BACKFILL

1. Place and compact backfill in excavations promptly, but not before completing the following:
  - a. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  - b. Surveying locations of underground utilities for Record Documents.
  - c. Testing and inspecting underground utilities.
  - d. Removing concrete formwork.
  - e. Removing trash and debris.
  - f. Removing temporary shoring, bracing, and sheeting.
  - g. Installing permanent or temporary horizontal bracing on horizontally supported walls.
2. Place backfill on subgrades free of mud, frost, snow, or ice.

## K. UTILITY TRENCH BACKFILL

1. Place backfill on subgrades free of mud, frost, snow, or ice.
2. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
3. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
4. Trenches under Roadways: Install pipe and backfill per utility owner's requirements. Install Low Strength Concrete (flowable fill) per City of [ **Evanston / Chicago** ] requirements up to the bottom of subbase.
5. Backfill voids with satisfactory soil while removing shoring and bracing.
6. Initial Backfill:
  - a. Soil Backfill: Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
    - 1) Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
  - b. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
7. Final Backfill:
  - a. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
  - b. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
8. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

## L. SOIL FILL

1. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
2. Place and compact fill material in layers to required elevations as follows:
  - a. Under grass and planted areas, use satisfactory soil material.
  - b. Under walks and pavements, use satisfactory soil material.
  - c. Under steps and ramps, use engineered fill.
  - d. Under building slabs, use engineered fill.
  - e. Under footings and foundations, use engineered fill.
3. Place soil fill on subgrades free of mud, frost, snow, or ice.

## M. SOIL MOISTURE CONTROL

1. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - a. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - b. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

## N. COMPACTION OF SOIL BACKFILLS AND FILLS

1. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
2. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
3. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - a. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  - b. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  - c. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
  - d. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

## O. GRADING

1. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - a. Provide a smooth transition between adjacent existing grades and new grades.
  - b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

2. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
  - a. Turf or Unpaved Areas: Plus or minus 1 inch.
  - b. Walks: Plus or minus 1 inch.
  - c. Pavements: Plus or minus 1/2 inch.
3. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

P. SUBSURFACE DRAINAGE

1. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
  - a. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
2. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
  - a. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
  - b. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

Q. SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

1. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
2. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  - a. Install separation geotextile (where needed and as directed) on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  - b. Place base course material over subbase course under hot-mix asphalt pavement.
  - c. Shape subbase course and base course to required crown elevations and cross-slope grades.
  - d. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
  - e. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - f. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

R. Field Quality Control:

1. Geotechnical Testing Agency: NU will typically engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
2. Testing agency will test compaction of soils in place according to ASTM D 1557, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 3500 sq. ft. or less of paved area or building slab, but in no case fewer than 2 tests.
4. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 250 feet or less of trench length, but no fewer than 1 test.
5. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, contractor shall scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.
6. Subgrade Inspection: Contractor shall notify NU's Geotechnical Testing Agency when excavations have reached required subgrade. If NU's Geotechnical Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
7. Proof-Rolling: Contractor shall proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Review requirements and additional compensation for authorized additional excavation and replacement material with NU during the design phase.
8. Unauthorized Excavation: Fill unauthorized excavations under other construction or utility pipe as directed by NU's Geotechnical Testing Agency.
9. Storage of Soil Materials: Contractor shall stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Contractor shall place, grade, and shape stockpiles to drain surface water and cover to prevent windblown dust. Contractor shall stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
10. Protection:
  - a. Protecting Graded Areas: Contractor shall protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
  - b. Contractor shall repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - c. Where settling occurs before Project correction period elapses, contractor shall remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

S. Hauling Routes:

1. Contractor must submit and have approved all planned hauling routes to and from Northwestern University to Facilities Management Operations prior to any site disturbance operations.

**END OF SECTION 31 2000**

NORTHWESTERN UNIVERSITY  
PROJECT NAME \_\_\_\_\_  
JOB # \_\_\_\_\_

FOR: \_\_\_\_\_  
ISSUED: 03/29/2017

**THIS PAGE IS INTENTIONALLY BLANK**