CITY OF FORT WAYNE MASTER UPDATED: 03/12/2018

SECTION 31 00 05

Trenching and Earthwork

NTS: This Section is intended for projects with excavation and fill work and linear utility projects. And is applicable for any project that contains excavation work, including horizontal directional drilling and pipe bursting. Additionally, general requirements for site fill and pavement subbase preparation is included. Based on project specific requirements remove information that is not applicable for project.

1. GENERAL
	1. DESCRIPTION

NTS: For multi-contract projects, coordinate the assignment of responsibility for excavation work by electrical contractor and, if required, by plumbing and HVAC contractors. Modify Paragraph 1.1.a.1 accordingly. Geotechnical report, if available, shall be used to coordinate the work described in this section. For complex projects, geotechnical and structural professionals shall review this section for compliance with recommendations and foundation design requirements.

* + 1. Scope:
			1. Contractor shall provide all labor, materials, equipment and incidentals required to perform all excavating, backfilling, filling and grading, and disposing of earth materials as shown, specified, and required for construction of structures, manholes, vaults, utilities, conduits, pipelines, roads, and any other facilities required to complete the Work in every respect.
			2. All necessary preparation of subgrade for walks, drives, slabs, and pavements is included.

NTS: Paragraph “3” below does not differentiate excavation materials, if a specific material that may require different excavation methods, such as rock, exists on project site, edit Paragraph “3” below as necessary to exclude the material. Insert after thereof , “except rock which is specified in the Contract Documents”. Incorporate additional work items to Article 1.2 of this section, as necessary.

* + - 1. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

NTS: For multi-contract projects, advise this Contractor (usually the general) in (--1--) below when another contractor will be responsible for some aspect of the work (e.g., “Electrical Contractor will perform excavation and backfilling for underground ductbanks.”). Coordinate with Paragraph 1.1.a.1, otherwise delete.

* + 1. Work Performed by Others:
			1. (--1--).
		2. Related Sections:

NTS: Insert at (--1--) below list of sections covering products, construction and equipment that a user might expect to find in this section, but are specified elsewhere. Include the project specific Div 33 pipe material section and specific pipe utility installation Sections, as applicable. Do not list administrative and procedural Division 01 sections.

* + - 1. Section 31 05 19, Geosynthetics for Earthwork.
			2. Section (--1--).

NTS: Section “1.2” is to be included if project is bid on unit price basis. Section to be deleted or revised if project is to be bid on lump sum basis.

NTS: Adjust Section “1.2” below for additional work item numbers as needed. Delete unused work items.

* 1. MEASUREMENT AND PAYMENT

NTS: Common Excavation is intended for items where the cost for excavation work is not included in any other pay items. The work item below includes the excavation to remove asphalt curbs and medians including the subbase. Edit Work Item “A” based on the project specific requirements. For open cut pipe Projects, the cost of excavation is included in the cost of the pipe.

* + 1. Common Excavation:
			1. Work Item Number and Title

 **31 00 05-A Common Excavation**

* + - 1. This item shall consist of all excavation which is not otherwise classified and paid for. Including the costs to remove all asphalt curbs, asphalt medians, and soils and subbase under the asphalt curb and median.
			2. Common excavation does not include excavation required for the installation of other Work items, including but not limited to utility piping, manholes, and structures. Unless specifically stated elsewhere, excavation required for the installation of other Work items shall be included in the measurement and payment of those Work items.
			3. The common excavation shall be measured in cubic yards for the removed material.
			4. The payment for common excavation shall be based on the unit price per cubic yard as listed on the submitted Bid schedule.

NTS: Special backfill is typically not included in the cost of the pipe and should be included as a separate work item. If special backfill is to be included as part of the pipe cost delete work item below and coordinate with the pipe material specification section. Special backfill is not included in the pay item for ductile iron fittings, edit as necessary based on project specific requirements. Delete work item below if not used.

* + 1. Special Backfill
			1. Work Item Number and Title

 **31 00 05-B Special Backfill, Compacted Aggregate**

* + - 1. This item shall include all costs to furnish all labor, materials, equipment, tools, and compacting required to place and compact Special Backfill material described as herein. Special Backfill is to be placed under roadway pavements, parking lots, and driveways, within the road right-of-way, or as shown on the Drawings.
			2. The cost for complete removal and hauling away of excavated material is included in respective specification for pipe material, manholes, structures, etc.
			3. The quantity of Special Backfill shall be calculated by the following equation:

$$ yd^{3}=\frac{\left(L\right)\left(D\right)(W)}{27}$$

 Where:

 yd3 = The quantity of Special Backfill in cubic yards.

 L = The actual length of a cut at the surface in feet requiring backfill

 material (ft).

 D = The vertical distances in feet from surface to a point one foot

 above the top of the pipe (ft).

 W = The width of the trench, in feet, having a maximum pay width of

 outside diameter + 2.5 ft.

* + - 1. The payment of Special Backfill shall be based on the unit price per cubic yard as listed on the submitted Bid schedule.
		1. Excavation of Unsuitable Material
			1. Work Item Number and Title

 **31 00 05-C Excavation of Unsuitable Material**

* + - 1. This item shall include all cost associated with excavation below bottom elevation of structure bedding, or as directed by Engineer, temporary sheeting, shoring, disposal of excavated material, dewatering, and erosion control.
			2. The quantity will be the cubic yard calculated in the rectangular cross section having a maximum width of 30 inches plus the outside diameter of the pipe laid therein. Depth shall be anything greater than 18 inches below the required pipe bedding, as is shown.
			3. The payment shall be on a unit price basis per cubic yard.
		1. Additional Special Backfill for Unsuitable Material
			1. Work Item Number and Title

 **31 00 05-D Additional Special Backfill for Unsuitable Material**

* + - 1. This item shall include all cost associated with furnishing, placing, and compaction of special backfill to replace excavated unsuitable material, as directed by the Engineer.
			2. The quantity will be the cubic yards calculated for the area below that shown on the plans and as directed by the Engineer.
			3. The payment shall be on a unit price basis per cubic yard.
		1. Flowable Fill
			1. Work Item Number and Title

 **31 00 05-E Flowable Fill as Backfill**

* + - 1. This item shall include all costs to furnish all labor, materials, equipment, and tools required to place Flowable Fill that shall meet the requirements set forth in INDOT Specification Section 213, current edition. Flowable Fill is to be placed as shown or specified on the Drawings. As necessary, disposal of native materials prior to installation of fill is included in this item unless included under a separate Work item.
			2. The quantity of Flowable Fill in place shall be the number of cubic yards within the allowable trench width as described herein.
			3. The payment of Flowable Fill shall be based on the unit price per cubic yard as listed on the submitted Bid schedule.

NTS: Retain paragraph “F” below if project requires using flowable fill for pipe abandonment. Coordinate with the specific DIV 33 Utility Installation Section.

* + 1. Flowable Fill
			1. Work Item Number and Title

 **31 00 05-F Flowable Fill for Pipe Abandonment**

* + - 1. This item shall include all costs to furnish all labor, materials, equipment, and tools required to place Flowable Fill that shall meet the requirements set forth in INDOT Specification Section 213, current edition. As necessary, disposal of native materials prior to installation of fill is included in this item unless included under a separate Work item.
			2. The quantity of Flowable Fill in place shall be calculated based on the volume of the pipe being abandoned.
			3. The payment of Flowable Fill shall be based on the unit price per cubic yard as listed on the submitted Bid schedule.

NTS: Remove item “G” below based on project specific requirements. Typically if paying for the item separately than the locations should be shown on the drawings.

* + 1. Owner Requested Spot Excavation for Utilities-Potholes
			1. Work Item Number and Title

**31 00 05-G Owner Requested Spot Excavation for Utilities**

* + - 1. Payment for spot excavation for utilities, or “potholes”, shall be per each excavation regardless of depth, pothole size, or excavation method.
			2. The pay quantity shall be the actual number of potholes actually excavated, backfilled, and repaired as specified or as requested by the Owner.
			3. Provide all Work necessary, including but not limited to, coordination and notification to affected utility companies for field marking each utility, providing field survey, obtaining required permits, submitting an approved traffic control plan, establishing and maintaining traffic control during utility locations, excavating, backfilling, disposing of excavated material, repairing surface (pavement, stone, concrete, grass, etc.).
			4. Contractor shall be responsible for maintenance of repaired surfaces and repair any settling that may occur.

NTS: Edit pay quantity for Item “H” below based on project specific requirements, add additional work items as required. Geosynthetics for aggregate separation are included in Section 31 05 19 – Geosynthetics for Earthwork.

* + 1. Riprap
			1. Work Item Number and Title

 **31 00 05-H Riprap**

* + - 1. This item shall include all cost associated with furnishing and placing riprap as directed by the Engineer. Including any earth excavation, subgrade preparation, material disposal and incidentals for performing all Work as specified unless otherwise broken down as a separate bid item.
			2. The quantity will be measured per square yard.

NTS: Item “I” below is to be included in overall project cost and not bid as a separate work item. Revise Section “1.2” as required for additional pay items not included specifically above. Other items may include bedding and test pits.

* + 1. Other Trenching and Earthwork:
			1. All other items listed in this specification are to be included in overall Project cost and not bid as a separate Work item.
	1. REFERENCES

NTS: Retain applicable standards and add others as required.

* + 1. Standards referenced in this Section are listed below:
			1. ASTM International:
				1. ASTM C495, Test Method for Compressive Strength of Lightweight Insulating Concrete.(Flowable Fill)
				2. ASTM D422, Test Method for Particle‑Size Analysis of Soils.
				3. ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft – lbf/ft3).
				4. ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft – lbf/ft3)
				5. ASTM D2166, Test Method for Unconfined Compressive Strength of Cohesive Soils.
				6. ASTM D4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
			2. Indiana Department of Transportation (INDOT) - Standard Specifications:
				1. 211, B Borrow and Structural Backfill
				2. 213, Flowable Backfill
				3. 616.05, Placing Revetment Riprap
				4. 901.01(b), Portland Cement
				5. 901.02, Fly Ash as a Pozzolan
				6. 904.01, Aggregates
				7. 904.02, Fine Aggregate
				8. 904.03, Coarse Aggregate
				9. 904.04, Riprap
				10. 912.03, Admixtures for Use in Concrete
				11. 913.01, Water
	1. QUALITY ASSURANCE

NTS: Edit Paragraph “A” below to suit depending on how the testing laboratory is to be hired (by the Owner, by Contractor). Required tests and test methods should be selected by a soils consultant or the structural group. Delete test methods not required.

* + 1. Testing Services:
			1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and testing of compaction for compliance with technical requirements of these Specifications shall be performed by a testing laboratory as specified in the Contract Documents. Testing shall conform to ASTM D422, ASTM D427, ASTM D1557, ASTM D 2166, ASTM D 698, and ASTM D4318.
			2. Contractor’s Laboratory Services Scope:
				1. Test proposed materials in the laboratory and/or field for compliance with the Contract Documents.
				2. Perform field moisture content and density tests to verify that the specified compaction of backfill materials has been obtained.
				3. Inspect and approve subgrades and fill layers are in compliance with the Contract Documents before further Work is performed thereon.
				4. Report test results to the Engineer.
			3. Authority and Duties of Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field, perform tests, and report their findings to the Engineer and Contractor. When the materials furnished or the Work performed fails to fulfill Specification requirements, the technician will direct the attention of the Engineer and Contractor to such failure.
				1. The technician shall not act as foreman or perform other duties for Contractor. Work will be checked as it progresses. Failure to detect any defective Work or materials at the time of installation shall not in any way prevent later rejection of the Work if defects are later discovered, nor shall it obligate the Engineer for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.
			4. Responsibilities and Duties of Contractor, relative to testing:
				1. The use of testing services shall in no way relieve Contractor of the responsibility to provide Work in full compliance with the Contract Documents.
				2. To facilitate testing services, Contractor shall:

Secure and deliver to the Engineer or to the testing agency, without cost, preliminary representative samples of the materials the Contractor proposes to use which are required to be tested.

Furnish such casual labor as is necessary to obtain and handle samples at the Site or at other sources of material.

Advise the laboratory service at least two days in advance of any backfill operations to allow for completion of quality tests and for the assignment of personnel.

* + - * 1. It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to control their operations by confirmation tests to verify and confirm that Contractor has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
				2. Contractor shall demonstrate the adequacy of compaction equipment and procedures to the Engineer before exceeding any of the following amounts of earthwork quantities:

200 linear feet of Special Trench Backfill.

10 cubic yards of structural backfill.

100 cubic yards of embankment work.

50 cubic yards of base material.

* + - * 1. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
				2. Periodic compliance tests may be made by the Engineer to verify that compaction is conforming to the requirements previously specified, at no cost to Owner. Contractor shall remove the overburden above the level at which the Engineer wishes to test and shall backfill and recompact the excavation after the test is complete.
				3. If compaction fails to conform to the specified requirements, Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by Contractor. Contractor confirmation tests shall be performed in a manner acceptable to the Engineer. Frequency of confirmation tests for remedial Work shall be double the amount specified for initial confirmation tests.

NTS: Delete Article “B” or edit testing to suit project.

* + 1. Quality Control Testing During Construction: Testing service shall inspect and approve subgrades and fill layers before construction Work is performed thereon. Tests of subgrades and fill layers shall be taken as follows:

NTS: Coordinate location and frequency of testing with structural group and soils consultant.

* + - 1. The frequency of Contractor confirmation tests shall be not less than as follows: Each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade.

NTS: Review the testing frequency and intervals specified below and edit if required. Typical testing frequencies and interval values have been specified.

Trenches for Underground Facilities:

In open fields: Two locations every 1,000 linear feet.

Along dirt or gravel roads or off traveled Right-of-Way: Two locations every 500 linear feet.

Crossing paved roads: Two locations along each crossing.

Under pavement cuts or within two feet of pavement edges: One location every 400 linear feet.

For Structural Backfill: On 30-foot intervals on all sides of the structure for every compacted lift, but no less than one per lift on each side of the structure for structures less than 60 feet long on a side.

In Embankment or Fill: One per 1,000 square feet on every compacted lift.

Base Material: One per 1,000 square feet on every compacted lift.

* + - 1. Copies of the test reports shall be submitted promptly to the Engineer. Contractor tests shall be performed by a soils testing laboratory acceptable to the Engineer.
			2. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least 1 test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Engineer.

NTS: Insert at (--1--) below the entity who is responsible for obtaining permits (Contractor, Owner, Engineer). Edit Section “C” to suit project.

* + 1. Permits and Regulations:
			1. (--1--) shall obtain all necessary permits for Work in roads, right-of-ways, railroads, and other property where permits are required. Also, obtain permits as required by local, state and federal agencies for discharging water from excavations.
			2. Perform excavation Work in compliance with applicable require­ments of governing authorities having jurisdiction.

NTS: Edit the submittal requirement to suit project.

* 1. SUBMITTALS
		1. Action Submittals: Submit the following:
			1. Samples:
				1. Submit samples of all select geotextiles, fill, gravel and base materials required: Deliver samples to Engineer.
			2. Product Data:
				1. Submit source of materials, and when gradation is specified, submit gradation test for each type of material specified.

NTS: Delete paragraph or edit below to suit project.

* + 1. Informational Submittals: Submit the following:

NTS: Degree of difficulty of excavation requires consultation with soils consultant and or dewatering expertise. For excavation of average or less difficulty, delete Paragraph “B.1”. No submittals required. Otherwise, retain Paragraph “B.1”. Use Paragraph “B.1” where sheeting must be specified because sheeting failure could damage existing adjacent facilities or new work, or could be very dangerous from a construction risk standpoint.

* + - 1. Delegated Design Submittals:
				1. Contractor shall prepare Shop Drawings for the following items:

NTS: Delete items below that do not apply.

Sheeting and bracing, or other protective system(s).

Dewatering system.

Cofferdams.

Underpinning.

NTS: Consult with soils consultant to determine the required submittals. Select version of Paragraph “b” below that applies or delete both if neither apply.

 b. Shop Drawings shall be prepared by a Professional Engineer, registered in the State of Indiana, recognized as expert in the specialty involved. Also, submit for approval, calculations and all other pertinent information. Contractor, however, will be responsible for designing, installing, operating and maintaining the system(s) as required to satisfactorily accomplish all necessary sheeting, bracing, protec­tion, underpinning, and dewatering.

 b. Drawings shall be prepared by a Professional Engineer, registered in the State of Indiana, recognized as expert in the specialty involved. Drawings shall be submitted to Engineer for record purposes only. Calculations shall not be submitted. Drawing submittals will not be checked and will not imply approval by Engineer of the Work involved. Contractor shall be solely responsible for designing, installing, operating and maintaining whatever system is necessary to satisfactorily accom­plish all necessary sheeting, bracing, protection, underpinning, and dewatering.

NTS: Paragraph “a” below requires a monthly submittal of field quality control tests. Edit the submittal frequency based on the type and duration of the project. Coordinate with the project standard submittal listing, include submittal package numbers for the duration of the project.

* + - 1. Site Quality Control Submittals:
				1. Submit Monthly Test Reports for Borrow, Backfill, and Grading: Testing laboratory shall submit copies of the following reports directly to Engineer, with copy to the Contractor:

Tests on borrow material.

Test of excavation subgrade, including footers.

Field density tests.

Optimum Moisture: Maximum density curve for each soil used for backfill.

Tests of actual unconfined compressive strength or bearing tests of each strata.

Tests of Flowable Fill.

* + - * 1. Submit the proposed compaction procedure and equipment to be used.
				2. Submit the proposed sheet shoring and bracing procedure and equipment to be used.
				3. Submit any additional reports from required field testing as specified in Part 3 of this specification.
			1. Qualifications Statements:
				1. Submit qualifications for earthwork testing agency.
	1. JOB CONDITIONS

NTS: Delete Paragraph “A” if subsurface boring data is not available. Coordinate with Information for Bidders, Division 1, General Conditions, Supplementary Conditions and Appendices, as required.

* + 1. Subsurface Information: Data on subsurface conditions is included in the Project Manual. It is not intended as a representation or warranty of continuity of conditions between soil borings nor of groundwater levels at dates and times other than date and time when measured. Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is solely made available for the convenience of Contractor.
			1. Additional test borings and other exploratory operations may be made by Contractor, at no additional cost to the Owner.

NTS: Coordinate Paragraphs “B”. “C”, “D”, and “E” below with Division 1, General Conditions, and Supplementary Conditions.

* + 1. Existing Underground Facilities: The Drawings show certain surface and underground structures and utilities adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of Contractor. Contractor shall explore ahead of the required excavation to determine the exact location of all structures. They shall be supported and protected from damage by Contractor. If they are broken or damaged due to the Contractor’s construction activities, then they shall be restored immediately by Contractor at no additional cost to the Owner.
			1. Locate existing Underground Facilities in the areas of the Work. If facilities are to remain in place, provide adequate means of protection during all operations.
			2. Should uncharted or incorrectly charted piping, structures, or other utilities be encoun­tered during excavation, consult utility owner and Engineer immediately for directions as to how to proceed. Cooperate with Owner and utility owner in keeping services and facilities in operation. Repair damaged utilities to satisfac­tion of utility owner.
			3. In general, service lines to individual houses and businesses are not shown. Contractor shall assume that services exist for each utility to each house or business.

NTS: Delete Paragraph “4” if not required.

* + - 1. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Engineer and utility owner and then only after acceptable temporary utility services have been provided.
			2. Demolish and completely remove from the Site existing Underground Facilities indicated to be removed. Coordinate with utility owner for shut‑off of services if lines are active.
		1. The use of explosives will not be permitted.
		2. Protection of Work and Property must conform to requirements in Contract Documents. Refer to Section 01 71 33 - Protection of Work and Property.
		3. Dust Control must conform to requirements in Contract Documents. Refer to Section 01 57 00 - Temporary Controls.
		4. Roadways and Walks: Unless otherwise approved by Engineer, excavated material and materials of construction shall be stockpiled, and the Work shall be conducted to maintain open and free for pedestrian traffic in all crosswalks, and for vehicular traffic, provide a roadway driving lane not less than ten feet wide. All hydrants, valves, fire alarm boxes, letterboxes, and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, Contractor shall maintain such crosswalks, sidewalks, and roadways in satisfactory condition, and the Work shall at all times be conducted to cause a minimum inconvenience to public travel and to permit safe and convenient access to private and public property along the line of the Work.
1. PRODUCTS

NTS: Obtain geotechnical input regarding products to be used (if available). Use materials readily accessible to the project.

* 1. BACKFILL MATERIALS – FOR UTILITY PIPING AND STRUCTURES

NTS: Specify other types of backfill where required or delete if not used. Coordinate locations with drawings. Coordinate and edit compaction requirements as required for each project.

NTS: Paragraph “A” below requires no organic matter. In general organic soils are very compressible and have poor load-sustaining properties. Organic matter is measured by a percentage and is based on the ash content in the soil. Organic matter in soil is measured using the test method listed in ASTM D2974. Based on project specific requirements edit the allowable organic matter percentage, coordinate with the project geotechnical engineer and report.

* + 1. Backfill:
			1. Materials acceptable for use as backfill for underground utilities, against walls, foundations, underground ductbanks, and other structures shall be stockpiled native sandy clay or granular soils obtained from on-site excavations and which are uniformly mixed, contain no organic matter, nor contain rocks or fragments greater than 3 inches in size, nor have greater than 40 percent passing the 200 sieve. The maximum expansion of on-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D698 at two percent below optimum moisture content under a 100 psf surcharge pressure.
			2. Backfill and fill materials from off-site sources shall consist of silty or clayey sand soils that are uniformly mixed, contain no organic matter and which have a Plasticity Index less than ten. The maximum particle size of imported soils shall be 3-inches or less, if required to satisfy trenching, landscaping, or other requirements. The maximum expansion of off-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D698 at two percent below optimum moisture content under a 100 psf surcharge pressure.
			3. All materials for use as backfill and fill material shall be tested by the laboratory services, as requested by the Engineer.
			4. If on-site material is unsuitable, as determined by the Engineer, Special Backfill or approved off-site fill shall be used.

NTS: Paragraph B contains requirements for INDOT 53/73 stone. If a different type of special backfill is required for project edit material in paragraph below. Identify locations for special backfill on the Contract Drawings.

* + 1. Special Backfill:
			1. Materials acceptable for use as special backfill for use beneath pavements and structures and as shown on Drawings, shall be in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications latest edition, Sections 211 and 904.
			2. The material shall be acceptable quality, free from large or frozen lumps, wood, or other extraneous matter.
			3. Special backfill shall be in accordance with gradations for No. 53 or No. 73 coarse aggregate in accordance with the gradation requirements of INDOT Standard Specifications latest edition, Section 904.03(e). Coarse Aggregate No. 53 or No. 73 shall be crushed stone or air-cooled blast furnace slag (ACBF), Class D or higher.

If “B” Borrow is required for project remove paragraph “C” below and replace with the following: Note that B-Borrow is an acceptable material for watermains outside of the edge of pavement, see detail BS5-1. Based on project specific requirements coordinate the drawings and specifications on the usability of B borrow.

1.“B”Borrow is defined in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications latest edition, Sections 211 and 904. The material shall be acceptable quality, free from large or frozen lumps, wood, or other extraneous matter. Material shall compliance with gradations for No. 30 to 1 1/2 inch in accordance with the gradation requirements of INDOT 211.

* + 1. “B” Borrow:
			1. Use of “B” Borrow is not acceptable.
				1. “B” Borrow is defined in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications latest edition, Sections 211 and 904.
	1. BEDDING MATERIALS - FOR UTILITY PIPING AND STRUCTURES

NTS: Edit Section “A” below to suit project requirements. Delete what is not applicable. If additional pipe materials are to be used list in appropriate category (rigid, flexible) below.

NTS: Include the appropriate bedding detail on the Drawings. Add in bedding dimensions, as applicable.

* + 1. Pipe Classifications
			1. The following pipe materials are classified as Rigid:
				1. Reinforced Concrete Pipe (RCP)
			2. The following pipe materials are classified as Flexible:
				1. Polyvinyl Chloride (PVC)
				2. High Density Polyethylene (HDPE)
				3. Fiberglass Reinforced Pipe (FRP)
				4. Ductile Iron Pipe (DIP)
				5. Corrugated Metal Pipe (CMP)
				6. Polypropylene Pipe (PP)

NTS: Coordinate the bedding material and compaction requirements listed below in Paragraphs “B-Ewith the specified pipe Manufacturer.

* + 1. Bedding for Rigid Pipes
			1. Compacted Granular Bedding Material: The compacted granular bedding shall consist of angular 1/4 inch to 1 1/2 inch, graded stone. INDOT Classification No. 5, No. 8 and No. 9 are acceptable. Required backfill is then placed on top of the compacted granular bedding.
			2. Shaped Subgrade Bedding with compacted granular bedding: The subgrade material shall be No. 8 crushed stone. The compacted granular bedding shall consist of angular, 1/4 inch to 1 ½ inch graded stone. INDOT Classification No. 5, No.8 or No. 9 is acceptable. Required backfill is then placed on top of the compacted angular bedding.

NTS: Delete Paragraph “C” or “D” below based on project specific requirements.

* + 1. Bedding for Flexible Pipes – Sanitary and Storm Sewers
			1. All flexible pipes shall be bedded in Class “F” (crushed stone) bedding. The compacted granular bedding material shall consist of angular, graded stone. INDOT Classification No. 5, No. 8, No. 9 are acceptable. The crushed stone shall be placed from a minimum depth beneath the pipe of the outer pipe diameter divided by eight (4 inch minimum) to the pipe’s springline. Compacted granular bedding material is then placed on top of the crushed stone, level across the trench, to a point a minimum of 12 inches above the crown of the pipe. Required backfill is then placed on top of the compacted angular bedding.

NTS: Coordinate bedding material and requirements with Drawings and the standard detail. Delete Paragraph D based on project specific requirements.

* + 1. Bedding for Flexible Pipes – Water
			1. All flexible pipes shall be bedded in (crushed stone) bedding. INDOT Classifications No. 5, No. 8, and No. 9 are acceptable. The crushed stone shall be placed from a minimum depth beneath the pipe of the outer pipe diameter divided by eight (4 inch minimum) to the pipe’s springline. Compacted granular bedding material is then placed on top of the crushed stone, level across the trench, to a point a minimum of 12 inches above the crown of the pipe. The compacted granular bedding material shall consist of angular, graded stone. Required backfill is then placed on top of the compacted angular bedding.

NTS: Edit Section “E” below based on project conditions, (i.e soil conditions or precast structures size. Coordinate with the Drawings.

* + 1. Bedding for Precast Concrete Structures
			1. Precast concrete base sections for structures shall be placed on a well graded, compacted granular bedding material. The compacted granular bedding material shall consist of angular, graded stone. INDOT Classification No. 5, No. 8, No. 9, in accordance with INDOT 211, is acceptable. The bedding course shall extend to the limits as shown on the Drawings.
	1. INDOT SIEVE ANALYSIS REQUIREMENTS
		1. The following lists the coarse aggregate sieve analysis requirements in accordance with INDOT Section 903:

|  |
| --- |
| INDOT – Sieve Analysis Requirements |
| Sieve Sizes  | COARSE AGGREGATE SIZES (PERCENT PASSING)  |
| COARSE GRADED | DENSE GRADED  |
| 2 | 5  | 8  | 9  | 11  | 12  | 43(1) |  91  | 53(1) |  73(1)  |
| 4 in. (100 mm)  |  |  |  |  |  |  |  |  |  |  |
| 3 1/2 in. (90 mm)  |  |  |  |  |  |  |  |  |  |  |
| 2 1/2 in. (63 mm)  | 100  |  |  |  |  |  |  |  |  |  |
| 2 in. (50 mm)  | 80-100  |  |  |  |  |  |  |  |  |  |
| 1 1/2 in. (37.5 mm)  |  | 100  |  |  |  |  | 100  |  | 100  |  |
| 1 in. (25 mm)  | 0-25  | 85-98  | 100  |  |  |  | 70-90  | 100  | 80-100  | 100  |
| 3/4 in. (19 mm)  | 0-10  | 60-85  | 75-95  | 100  |  |  | 50-70  |  | 70-90  | 90-100  |
| 1/2 in. (12.5 mm)  | 0-7  | 30-60  | 40-70  | 60-85  | 100  | 100  | 35-50  |  | 55-80  | 60-90  |
| 3/8 in. (9.5 mm)  |  | 15-45  | 20-50  | 30-60  | 75-95  | 95-100  |  |  |  |  |
| No. 4 (4.75 mm)  |  | 0-15  | 0-15  | 0-15  | 10-30  | 50-80  | 20-40  |  | 35-60  | 35-60  |
| No. 8 (2.36 mm)  |  | 0-10  | 0-10  | 0-10  | 0-10  | 0-35  | 15-35  |  | 25-50  |  |
| No. 30 (600 μm)  |  |  |  |  |  | 0-4  | 5-20  |  | 12-30  | 12-30  |
| No. 200 (75 μm)(2)  |  |  |  |  |  |  | 0-6.0  |  | 5.0-10.0(4) |  5.0-12.0  |
| Decant (PCC)(3) |  |  0-1.5  | 0-1.5  | 0-1.5  | 0-1.5  | 0-1.5  |  | 0-1.5  |  |  |
| Decant (Non-PCC)  | 0-2.5  | 0-2.5  | 0-3.0  | 0-2.5  | 0-2.5  | 0-2.0  |  | 0-2.5  |  |  |
| Notes: 1. The liquid limit shall not exceed 25 (35 if slag) and the plasticity index shall not exceed 5. The liquid limit shall be determined in accordance with AASHTO T 89 and the plasticity index in accordance with AASHTO T 90. 2. Includes the total amount passing the No. 200 (75 μm) sieve as determined by AASHTO T 11 and T 27. 3. Decant may be 0-2.5 for stone and slag. 4. When slag is used for separation layers as defined in 302.01, the total amount passing the No. 200 (75 μm) sieve shall be 10.0 to 12.0.  |

NTS: Edit or delete Article “2.4” below based on project specific requirements. Add additional riprap materials and gradations as necessary for project.

* 1. RIP RAP
		1. Revetment Riprap
			1. Provide revetment Riprap in accordance with INDOT Section 904.04, class F or higher, with a maximum dimension of 3 times the minimum dimension.
			2. The aggregate shall be as defined by INDOT Standards for revetment riprap, must be crushed stone, and must meet the following gradations:

|  |
| --- |
| INDOT Revetment Riprap Gradation |
| **Percent Smaller** |
| **Size, in.** | **Revetment** |
| 30 |  |
| 24 |  |
| 18 | 100 |
| 12 | 90-100 |
| 8 |  |
| 6 | 20-40 |
| 3 | 0-10 |
| 1 |  |
| Depth of Riprap | 18 inches |

* + 1. Hand-Laid Riprap
			1. Hand-laid aggregate shall consist of pieces, except spalls, not less than 1/3 cubic feetin volume and no less than 3” in the least diameter. The width of each piece shall be no less than 6” for 6” hand-laid riprap, or less than 12” for 12” hand-laid riprap.
			2. The aggregate shall be as defined by INDOT Standards for revetment riprap, must be crushed stone and must meet the following gradations:

|  |
| --- |
| INDOT Hand Laid Riprap Gradation |
| **Percent Smaller** |
| **Size, in.** | **Hand Laid** |
| 30 |  |
| 24 |  |
| 18 | 100 |
| 12 | 90-100 |
| 8 |  |
| 6 | 20-40 |
| 3 | 0-10 |
| 1 |  |
| Depth of Riprap | 18 inches |

* + 1. Grouted Riprap
			1. Grouted riprap aggregate shall comply with the requirements for hand-laid riprap. The grout shall be comprised of 1 part Portland Cement and 4 parts No. 23 fine aggregate per INDOT 904.01. The cement and fine aggregate may be dry-mixed in an approved mixer or by hand in a watertight box until the color of the mixture becomes uniform. Water shall be added as the mixing continues until the grout attains a consistency that will allow it to flow into the openings.

NTS: Remove Article “2.5” below if not required for project. Note that if project requires pipe abandonment utilizing flowable fill retain the following paragraph and coordinate with the appropriate DIV 33 utility installation specification. Material detailed below is for excavatable flowable fill, edit as required based on project specific conditions.

* 1. FLOWABLE FILL
		1. Flowable fill may be utilized at utility crossings, utility abandonment and other such instances as determined by the Engineer.
		2. Flowable Fill: Self-compacting flowable cementitious concrete material shall be produced from the following:
			1. Cementitious material (Portland cement and flyash): 100 to 350 lbs
			2. #23 washed sand: 2000 to 3000 lbs
			3. Water: 30 to 40 lbs (water to cement ratio= 1.0 to 1.5)
			4. Air: 10 to30% (Use Flowable Fill Performance Admixture – Eucon Easy Fill or equal)
			5. Maximum 200 psi compressive strength recommended
		3. Diameter of spread shall be greater than or equal to 8 inch.
1. EXECUTION
	1. INSPECTION
		1. Provide Engineer with 2 business days notice and with means to examine the areas and conditions under which excavating, filling, and grading are to be performed. Engineer will notify Contractor, in writing, if conditions are found that may be detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.
	2. TEST PITS
		1. General:

NTS: Select either Paragraph “1” as appropriate. Delete the paragraph not used.

* + - 1. Contractor shall excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities and structures. Contractor shall perform all the Work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling and replacing pavement for the test pits.
				1. Contractor shall be responsible for the definite location of each existing facility involved within the area of excavation for the Work under this Contract. Care shall be exercised during such location work to avoid damaging and/or disrupting the affected facility. Contractor shall be responsible for repairing, at his expense, damage to any structure, piping, or utility caused by his Work.
			2. Where shown or directed by Engineer, excavate and backfill, in advance of construction, test pits to determine conditions or location of existing facilities. Perform all Work required in connection with excavating, stockpil­ing, maintaining, sheeting, shoring, backfilling and replacing pavement for the test pits.

NTS: Retain Article “3.3” below if project includes Owner requested spot excavations. Delete if not used. Typically, these locates are used when specific locations are shown on the Drawings.

* 1. OWNER REQUESTED SPOT EXCAVATION FOR UTILITIES - POTHOLES
		1. General:
			1. Spot excavate or pothole all utility locations, public and private at locations shown on the Drawings, and where requested.
			2. Minimal disturbance excavation methods such as vacuum extraction are preferred; however, excavation methods shall be chosen to adequately define the utility location.
		2. Location Survey:
			1. Field locate potholed utilities including horizontal ties (minimum 2 required per locate) as well as depths.
			2. Coordinate the pothole locations with the same survey controls as the entire project.
			3. Provide sketches or red-lined project drawings denoting vertical and horizontal information, utility size, and material.
		3. Pothole Backfilling and Pavement Repair:
			1. Backfill and repair potholes consistent with the requirements of the permitting jurisdiction and restore to original condition.

NTS: Article “3.4” Dewatering details specific requirements for dewatering and is intended for use when significant dewatering is anticipated. Edit or delete based on the project specific requirements and the requirements listed in the geotechnical report. Need to coordinate Article with Delegated Design submittal, and the basic dewatering requirements.

* 1. DEWATERING
		1. Dewatering – General:
			1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the Underground Facilities to be built therein area acceptable to Engineer and backfilling operations are completed and acceptable to Engineer.
			2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
			3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
			4. Contractor shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
			5. Remove water from excavations as fast as water collects.

NTS: Delete Paragraph “B”, below, when not required. In paragraph “B.1”, insert at (--1--) the depth in feet when it is desired to maintain groundwater level a specific distance below bottom of excavation.

* + 1. Temporary Dewatering System:
			1. Contractor shall design, provide, and operate dewatering system to include sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, and similar facilities, necessary to depress and maintain groundwater level (--1--) below the base of each excavation during all stages of construction operations.
			2. Design and operate dewatering system to avoid settlement and damage to existing structures and Underground Facilities.
			3. Groundwater table shall be lowered in advance of excavation for a sufficient period of time to allow dewatering of fine grain soils.
			4. Maintain groundwater level at excavations two feet below lowest subgrade excavation until the structure or Underground Facility, as applicable, has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater.
			5. Operate dewatering system continuously, 24 hours per day, seven days per week. Provide standby pumping facilities and personnel to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without first obtaining Engineer’s acceptance for such discontinuation.
			6. If, in Engineer’s opinion, the water levels are not being lowered or maintained as required, provide additional or alternate temporary dewatering devices as necessary, at no additional cost to Owner.
			7. Locate elements of temporary dewatering system to allow continuous dewatering operation without interfering with the Work to the extent practicable.
			8. Where portions of dewatering system are located in the area of permanent construction, submit to and obtain Engineer’s acceptance of details of proposed methods of constructing the Work at such location. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads.
			9. Perform pumping of water from excavations in a manner that prevents carrying away of unsolidified concrete materials, and that avoids damaging the subgrade.
			10. Before discontinuing dewatering operations or permanently allowing rise of groundwater level, prepare computations to demonstrate that structures affected by the water level rise are protected by fill or other means to sustain uplift. Use a safety factor of 1.25 when preparing such calculations.
		2. Disposal of Water Removed by Dewatering System:
			1. Contractor’s dewatering system shall discharge to suitable location acceptable to Owner and owners of other properties potentially affected by water discharge, including owners adjacent to and downstream of dewatering system discharge. Operation dewatering system and disposal of water shall be in accordance with Laws and Regulations.
			2. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
			3. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
			4. Dispose of water in manner that causes no inconvenience to Owner, others involved in the Project, and adjacent and downstream properties.
	1. GENERAL EXCAVATION

NTS: Paragraph “A” below does not differentiate excavation materials. If a specific material that may require different excavation methods, such as rock, exists on project site, edit Paragraph “A” below as necessary to exclude the material. Add in additional work items to Article 1.2 of this specification, as necessary.

* + 1. Perform all excavations required to complete the Work as shown, specified and required. Excavations shall include earth, sand, clay, gravel, hardpan, boulders not requiring drilling and blasting for removal, decomposed material, pavements, rubbish, abandoned utilities and all other materials within the excavation limits.
		2. Provide excavation protection system(s) required by ordinances, codes, Laws, and Regulations to prevent injury to workers and to prevent damage to new and existing structures or utilities.
		3. Where the structure or utility is to be placed below the ground water table, use well points, cofferdams or other acceptable methods to permit construction of said structure or pipeline under dry conditions. Dry conditions shall be maintained until concrete has reached sufficient strength to withstand earth and hydrostatic loads and until the pipelines are properly jointed, tested and acceptably backfilled. Water level shall be maintained below subgrade until backfilling and compaction is completed.
		4. Pumping of water from excavations shall be completed in such a manner to prevent the carrying away of unsolidified concrete materials, and to prevent damage to the existing subgrade.

NTS: Delete Article “E” below if project does not require the construction of buildings and foundations.

* + 1. The elevation of the bottom of footings shown shall be considered as approximate only and Engineer may direct such changes in dimensions and elevations as may be required to secure a satisfactory footing. All structure excavations shall be hand‑trimmed to permit the placing of full widths, and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.
		2. Subgrades for roadways, structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with crushed stone or gravel. The finished elevation of stabilized subgrades shall not be higher than subgrade elevations shown.

NTS: Coordinate the requirements for proof rolling listed in paragraph “H” below with requirements listed in the Div 32 paving specifications sections.

* + 1. Prior to placement of aggregate base for roadways, subgrade more than 100 feet in length shall be proof-rolled with a tri-axle dump truck loaded with 20 tons and approved by the Engineer. There shall be one or two complete coverages as directed by the Engineer. Tire tracks, irregularities, or failures shall be corrected.
	1. UNAUTHORIZED EXCAVATION
		1. All excavation outside the lines and grades shown, and which is not approved by Engineer, together with the removal and disposal of the associated material shall be restored at Contractor’s expense. Unauthorized excavations shall be filled and compacted with backfill, or fill material as approved by Engineer, or concrete by Contractor at no additional cost to the Owner. Claims and damages resulting from unauthorized excavation will be the sole responsibility of the Contractor.

NTS: Coordinate Section “3.7” below with the requirements in Section 01 57 00 Temporary Controls and Section 01 57 13 Erosion and Sediment Control. Consider requiring a dewatering plan based on project.

* 1. EROSION CONTROL, DRAINAGE AND DEWATERING
		1. Erosion control, drainage, and dewatering must conform to requirements in Contract Documents. Refer to Section 01 57 13 Erosion and Sedimentation Control.
	2. SHEETING, SHORING AND BRACING

NTS: Edit Paragraph “A” to suit the project. Delete inapplicable requirements.

* + 1. General:
			1. Material utilized for sheeting, shoring, and bracing shall be in good condition, not damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary Work.
			2. Unless otherwise shown, specified, or directed, all materials used for temporary construction shall be removed when Work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
			3. Safe and satisfactory sheeting, shoring and bracing shall be the entire responsibility of Contractor.

NTS: Delete Paragraph “B” below if not applicable or modify to suit specific project soil conditions.

* + 1. Sheeting Left in Place:
			1. Steel sheet piling to be left in place shall consist of rolled sections of the continuous interlocking type, unless otherwise approved. The type and design of the sheeting and bracing shall conform to the Drawings. Steel sheeting designated to be left in place shall be new.
			2. Steel sheet piling to be left in place shall be driven straight to the lines and grades as shown or directed. The piles shall penetrate into firm materials with secure interlocking through­out the entire length of the pile. Damaged piling having faulty alignment shall be pulled and replaced by new piling.
			3. The type of guide structure used and method of driving for steel sheet piling to be left in place shall be subject to the approval of Engineer. Jetting will not be permitted.
			4. Cut off piling left in place to the grades shown or directed by Engineer and remove the cut off pilings from the Site.
			5. Clean wales, braces and all other items to be embedded in the permanent structure, and ensure that the concrete surrounding the embedded element is sound and free from air pockets or harmful inclusions. Provisions shall include the cutting of holes in the webs and flanges of wale and bracing members, and the welding of steel diaphragm waterstops perpendicular to the centerline of brace ends which are to be embedded.
			6. Subsequent to removal of the inside face forms, and when removal of bracing is permitted, cut back steel at least 2 inches inside the wall face and patch opening with cement mortar. Concrete shall be thoroughly worked beneath wales and braces, around stiffeners and in any other place where voids may be formed.
			7. Portions of sheeting or soldier piles and breast boards which are in contact with the foundation concrete shall be left in place, together with wales and bracing members which are cast into foundation or superstructure concrete.
		2. Shop Drawings for sheeting, shoring and bracing shall be submitted for record; they will not be reviewed.
	1. TRENCH SHIELDS
		1. Excavation of earth material below the bottom of a shield shall not exceed the limits established by ordinances, codes, Laws, and Regulations.
		2. When using a shield for the installation of structures, the bottom of the shield shall not extend below the top of the bedding for the structures.
		3. When a trench shield is removed or moved ahead, care shall be taken to prevent the movement of pipe or structures and the disturbance of the placed bedding and backfill for pipe or structures. Pipe, structures, bedding and backfill that are disturbed shall be removed and reinstalled as specified.
	2. GENERAL REQUIREMENTS FOR BEDDING, BACKFILL, AND COMPACTION
		1. Furnish, place and compact all Special Backfill, backfill, fill, bedding and other materials required for structures, embankments, pipelines, ductbanks, and other requirements.
		2. Provide the finished grades as shown and as described herein to be furnished, placed and compacted by Contractor.
		3. Backfill excavations as promptly as Work permits, but not until completion of the following:

NTS: Edit or delete the following paragraphs to suit project.

* + - 1. Inspection, successful completion and acceptance of testing, approval, and recording of locations of Underground Facilities.
			2. Removal of concrete formwork.
			3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.

NTS: Edit or delete paragraphs “4”, “5”, and “6” to suit project. Paragraphs “4”, “5”, and “6 are used for building foundations.”

* + - 1. Acceptance by the Engineer of construction below finish grade, including dampproofing, waterproofing and perimeter insulation.
			2. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
			3. Placement of settlement plates.
			4. Removal of trash and debris.
		1. Fill containing organic materials or other unacceptable material shall be removed and replaced with approved fill material as specified.
		2. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, the excavation shall be backfilled to the required subgrade with special backfill material and thoroughly compacted as specified. Sides of the excavation shall be sloped in accordance to the maximum inclinations specified for each structure location.

NTS: Insert at (--1--) below the project specific material lift depth requirements. If available coordinate with geotechnical report. The lift depth requirement is typically 6-inch, edit to suit project. Coordinate with Paragraphs A-E above.

Check geotechnical report, 95% density is not the same between Standard Proctor Test and Modified Proctor Test. Edit compaction requirements below based on geotechnical reports. If pipe is to be backfilled with native backfill verify appropriate compation density requirements. Typically native backfill does not meet the 95% Modified Proctor compaction density. requirements

* + 1. Compaction Density Requirements:
			1. The degree of compaction required for all types of backfill, special backfill, fills and bedding shall be 95 percent density as determined by the Modified Proctor Test or as approved by Engineer. Compaction may be obtained by mechanically tamping the material in (--1--) inch lifts. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.
				1. All backfill, special backfill and fill must be wetted and thoroughly mixed to achieve +2% or -1% of the optimum moisture content, with the following exceptions: On-site clayey soils optimum to plus 3 percent.
				2. Natural undisturbed soils or compacted soil subsequently disturbed or removed by construction operations shall be replaced with materials compacted as specified above.
			2. Testing service shall perform tests required to provide data for selection of backfill, special backfill, fill, and bedding material and control of placement water content.
			3. Field density tests, to ensure that the specified density is being obtained, shall be performed by testing service during each day of compaction Work.
			4. If the tests indicate unsatisfactory compaction, Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction Work shall be performed by Contractor, at no additional cost to the Owner, until the specified compaction is obtained. This Work shall include complete removal of unacceptable (as determined by the Engineer) fill areas and replacement and recompaction until acceptable backfill, special backfill, fill and bedding is provided.
			5. Compaction shall be performed with equipment suitable for the type of material being placed. Contractor shall select equipment that is capable of providing the minimum density required by these Specifications. Hand operated compacting equipment shall be used within a distance of ten feet from the wall of any completed below grade structure. Equipment shall be provided that is capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected by Contractor shall be tested at the commencement of compaction Work by construction of a small section of material within the area where the material is to be placed. If tests on this section of material show that the specified compaction is not obtained, Contractor shall increase the amount of coverage, decrease the lift thicknesses or obtain a different type of compactor.
			6. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe, manholes, inlets or structures.

NTS: Delete section “G” below when project does not contain water main services. Edit to suit project specific requirements.

* + 1. Complete compaction testing requirements for water services excavations within roadway. Compaction testing for water service excavations outside of roadway will be on an as need basis and paid for by Contractor at no additional cost to the Owner.
	1. UTILITY PIPING TRENCHING, BEDDING, BACKFILL AND COMPACTION
		1. Pipe trench preparation:

NTS: Open trench length requirement below may be shortened to 100 feet or less, if required by job conditions.

Based on project-specific conditions, include additional requirements for projects that are near a stream, ditch or waterway.

* + - 1. No more than 200 feet of trench may be opened in advance of pipe laying. Trenches in rock shall be fully opened at least 30 feet in advance of where pipe is being laid.
			2. Trench width shall be minimized to the greatest extent practical, but shall conform to the following:
				1. Sufficient to provide room for installing, jointing and inspecting piping.
				2. Sufficient for shoring and bracing, or shielding and dewatering.
				3. Sufficient to allow thorough placement and compaction of backfill adjacent to bottom half of pipe.
			3. Where the existing material beneath the bedding material is considered unsuitable by Engineer, Contractor shall remove and replace it with backfill or fill material as approved by Engineer.
			4. Depth of trench shall be as shown. If required and approved by Engineer, in writing, depths may be revised.
			5. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
				1. Locate and retain soil materials away from edge of excavations.
				2. Do not store within drip line of trees to be protected.
				3. Dispose of excess soil material and waste materials as specified hereinafter.
				4. Stockpiled excavated soils for use as subsequent fill shall be classified by laboratory as on-site granular or sandy clay soils. Use and placement of fill shall be performed as specified for each class.

NTS: Based on project specific conditions the pipe manufacturer may have differing pipe bedding types and classes. Edit Paragraph “B” as required for varying trench bedding conditions.

* + 1. Placement of pipe bedding:
			1. Bedding materials, both below the bottom and above the crown of the pipe, classes of bedding to be used, and placement and compaction of bedding materials shall conform to the following requirements:
				1. Granular bedding shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.
				2. After each pipe has been graded, aligned, placed in final position on the bedding material and shoved home, sufficient pipe bedding material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and to maintain alignment during subsequent pipe jointing and bedding operations.
				3. Bedding material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
				4. The bedding material shall then be placed and compacted to a level elevation 12 inches above the top of pipe across the trench.
				5. Each layer of bedding material shall be compacted by at least two complete coverages of all portions of the surface of each lift using appropriate compaction equipment. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of the compacting surface of the compactor.
				6. The degree of compaction required for granular bedding is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698.

NTS: Make clear on Contract Drawings the required location of special backfill and backfill. Coordinate with Paragraph “C” below.

* + 1. Backfill or special backfill in pipe trenches:
			1. Special backfill and backfill shall be placed to the grades shown. Bring special backfill, backfill around structures and piping up evenly on all sides. The lift thickness and compaction moisture content range given herein is approximate. These values shall be finally determined from the laboratory test results on the materials.
			2. Compacted special backfill shall be required for the full depth of the trench above the granular pipe bedding material. Where the trench for one pipe passes beneath the trench for another pipe or electrical ductbank, the lower trench shall be compacted to the level of the bottom of the upper trench.
			3. Place all special backfill in pipe trenches which are below structures, other pipes, or paved areas, in horizontal layers or lifts not exceeding 6 inches in depth and thoroughly compact each before the next layer or lift is placed.
			4. In other pipe trenches, compacted layers shall be 6 inches up to the pipe center line and 8 inches thereafter.
			5. Prior to the installation of pipes which are to be installed in fill sections, place the fill as described herein, until a minimum height of two feet above the soffit of the pipe is reached, unless otherwise required in other Sections. The fill for the trench width shall then be excavated and the pipe installed and backfilled. The remainder of the fill shall then be placed.
			6. Pipeline trenches may be backfilled prior to pressure testing, but no structure shall be constructed over any pipeline until it has been tested.
			7. The degree of compaction required for special and native backfill is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698.
	1. MANHOLES AND DRAINAGE STRUCTURES-TRENCHING, BEDDING, BACKFILL AND COMPACTION
		1. Trench preparation:
			1. Trench size shall be minimized to the greatest extent practical, but shall conform to the following:
				1. Sufficient to provide room for installing, jointing and inspecting manhole or inlet.
				2. Sufficient for shoring and bracing, or shielding and dewatering, as required.
				3. Sufficient to allow thorough placement and compaction of backfill and bedding adjacent to structure.
				4. Where the existing material beneath the bedding material is considered unsuitable by Engineer, Contractor shall remove and replace it with backfill or fill material as approved by Engineer.
		2. Placement of bedding:
			1. All manholes and structures shall be placed on required bedding, as described within this Section.
			2. Approved pipe bedding material (crushed stone #5, #8 or #9, per pipe bedding detail) must be used for backfill to an elevation of 12 inch above crown of all influent/effluent pipes.
		3. Placement of backfill or special backfill:
			1. Backfill or special backfill should be placed evenly around manhole in 6 inch maximum lifts and should be thoroughly tamped to standard proctor density referenced herein, before the next layer is installed.

NTS: Edit Article “3.12” to suit project, delete if not required. Coordinate with project standard details provided on drawings and geotechnical report if available. This Article is for projects that require site cut and fill work and building foundation development, or special structures such as outfall headwalls.

* 1. SITE WORK AND SPECIAL STRUCTURES – BACKFILL AND COMPACTION
		1. Special backfill and backfill shall be placed to the grades shown. Bring special backfill, backfill around structures and piping up evenly on all sides. The lift thickness and compaction moisture content range given herein is approximate. These values shall be finally determined from the laboratory test results on the materials.
		2. All special backfill shall be placed in horizontal loose lifts, not exceeding 8 inches in thickness, and shall be mixed and spread in a manner assuring uniform lift thickness after placing. Each lift shall be compacted by not less than two complete coverages of the specified compactor. Special backfill shall be placed to the underside of all concrete slabs. The material shall extend a minimum of 2 feet outside the face of each structure and be 12 inches below finished grade on all structures. When used under concrete slabs with exposed edges, the maximum slope of special backfill to the subgrade shall be one vertical to one horizontal.
		3. Backfill and fill around and outside of structures and over special backfill shall be deposited in layers not to exceed 8 inches in uncompacted thickness and mechanically compacted, using platform type tampers.
		4. Keep excavations dry during backfilling operations. No special backfill, backfill or fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed.
		5. General – Compaction of Special Backfill, Backfill, and Fill:
			1. Compaction of structures backfilled by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented.
			2. Compaction of special backfill and/or backfill by inundation with water will not be permitted. All materials shall be deposited as specified herein and as shown on the Drawings.
			3. The material shall be placed at a moisture content and density as specified. Contractor shall provide equipment capable of adding measured amounts of water to the backfill and/or special backfill material to bring it to a condition within the range of the required moisture content.
			4. Contractor shall provide equipment capable of discing, aerating, and mixing the soil to ensure reasonable uniformity of moisture content throughout the fill material and to reduce the moisture content of the borrow material by air drying, if necessary. If the subgrade or lift of earth material must be moisture conditioned before compaction, the fill material shall be sufficiently mixed or worked on the subgrade to ensure a uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of the specified limit shall be dried by aeration or stockpiled for drying.
			5. No compaction of fill will be permitted with free water on any portion of the fill to be compacted. No fill shall be placed or compacted in a frozen condition or on top of frozen material.
			6. Any fill containing organic materials or other unacceptable material previously described shall be removed and replaced with approved fill material prior to compaction.
			7. Levels of special backfill or backfill against concrete walls shall not differ by more than 2 feet on either side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs. Particular care shall be taken to compact structure special backfill or backfill, which will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structure special backfill or backfill, the structure special backfill or backfill shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.
			8. The compaction requirements specified are predicated on the use of normal materials and compaction equipment. In order to establish criteria for the placement of a controlled fill so that it will have compressibility and strength characteristics compatible with the proposed structural loadings, a series of laboratory compaction and/or compressive strength tests shall be performed on the samples of materials submitted by Contractor. From the results of the laboratory tests, the final values of the required percent compaction, the acceptable compaction moisture content range, and the maximum permissible lift thickness will be established for the fill material and construction equipment proposed.
			9. Control the water content of fill material during placement within the range necessary to obtain the compaction specified. In general, the moisture content of the fill shall be within three percent of the optimum moisture content for compaction as determined by laboratory tests. Perform all necessary Work to adjust the water content of the material to within the range necessary to permit the compaction specified.
			10. Compact fill shall be compacted by at least 2 coverages of all portions of the surface of each lift by compaction equipment. One coverage is defined as the condition obtained when all portions of the surface of the fill material have been subjected to the direct contact of the compactor.
			11. If the specified densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly functioning compaction equipment, Contractor shall perform whatever Work is required to provide the required densities. This Work shall include complete removal of unacceptable special backfill, backfill and fill areas, and replacement and recompaction until acceptable material is provided, at no additional cost to the Owner.
			12. Contractor shall repair, at his own expense, any after settlement that occurs, during the warranty period. Contractor shall make all repairs and replacements required within 30 days after notice from Engineer or Owner.
	2. ELECTRICAL DUCTBANK TRENCHES - BACKFILL OR SPECIAL BACKFILL
		1. Compacted backfill or special backfill, shall be required for the full depth of the trench, below and above the electrical ductbank. Where the trench for one ductbank passes beneath the trench for another pipe or ductbank special backfill shall be placed and compacted to the level of the bottom of the upper trench.
		2. Placement and compaction of backfill in electrical ductbank trenches shall conform to the requirements specified within this Section.
	3. FLOWABLE FILL

NTS: Coordinate Sections “A”, “B” and “C” below with project requirements and contract documents.

* + 1. Flowable Fill: Place initial backfill of flowable fill to a height of 12 inches over the pipe or conduit. Coordinate backfilling with testing.
		2. Flowable Fill: Place final backfill of flowable fill to final subgrade elevation.
		3. Flowable Fill: Place flowable fill inside the utility to complete fill the utility to be abandoned.

NTS: Edit or delete Article “3.15” below if not used on project. Add/edit installation requirements below if project requires additional riprap material types. Note that Uniform Rip Rap for Gabions and Revetment Mattresses is specified in Section 31 36 10- Gabions and Revetment Mattresses. If project includes those product coordinate rip rap requirements.

* 1. RIPRAP
		1. Revetment Riprap
			1. Install revetment riprap in accordance with INDOT Section 616.05. Riprap may be placed by dumping and shall be placed to the required thickness. The finish surface shall be free from clusters of small stones or of large ones. The finished surface shall vary from a true plane no more than 9 inches for revetment riprap as indicated on drawings.
			2. Install an aggregate separation geosynthetic layer in accordance with Section 31 05 19, Geosynthetics for Earthwork.
		2. Hand-Laid Riprap
			1. Hand-laid riprap shall be placed to produce a surface of approximate regularity with edges having projections no more than 3 in. above the required cross section.
		3. Grouted Riprap
			1. Aggregate, preparation of the slope, and depth of riprap aggregate shall be in accordance with INDOT section 616.05. All openings shall be filled with cement grout. Finished surface shall be approximately smooth, solid, and true to line, grade, and section.

NTS: Delete Article “3.16” below if no embankments. Insert at number (--1--) either “90” or “95”. Coordinate with geotechnical report.

* 1. EMBANKMENTS
		1. To the maximum extent available, use excess earth obtained from structure and trench excavations for construction of embankments. Obtain additional material from borrow pits as necessary. After preparation of the embankment area, level and roll the subgrade so that surface materials of the subgrade will be compact and well bonded with the first layer of the embankment. All material deposited in embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials. Construct embankments in horizontal layers not exceeding 8 inches in uncompacted thickness. Spread and level material deposited by excavating and hauling equipment prior to compaction. Thoroughly compact each layer by rolling or other method acceptable to the Engineer to (--1--) percent of the maximum density at optimum moisture content as determined by ASTM D1557. If the material fails to meet the density specified, compaction methods shall be altered. Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 24 inches above the top of the pipe before the trench is excavated.
	2. GRADING
		1. General: Uniformly grade areas within limits of grading as shown or specified, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

NTS: Delete Paragraph “B” below if not required.

* + 1. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
		2. Finish surfaces free from irregular surface changes, and as follows:
			1. Turfed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than 1-inch above or below the required subgrade elevations.
			2. Walks: Shape surface of areas under walks to line, grade and cross‑section, with finish surface not more than 1-inch above or below the required subgrade elevation.
			3. Pavements: Shape surface of areas under pavement to line, grade and cross‑section, with finish surface not more than 1/2 inch above or below the required subgrade elevation.
		3. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a ten foot straightedge.
		4. Compaction:
			1. After grading, compact subgrade surfaces to the depth and percentage of maximum required for each area classification.

NTS: Delete Article “3.18” if subbase course is not required or edit as required to suit project.

* 1. PAVEMENT SUBBASE COURSE
		1. General: Place subbase material, in layers of specified thickness, over subgrade surface to support pavement base course.
			1. Refer to Division 32 Specifications for paving requirements.
		2. Grade Control: During construction, maintain lines and grades including crown and cross‑slope of subbase course.
		3. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12 inch width of shoulder simultaneously with compacting and rolling of each layer of subbase course.
		4. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross‑section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
			1. When a compacted subbase course is shown to be 6 inches thick or less, place material in a single layer. When shown to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.
	2. DISPOSAL OF EXCAVATED MATERIALS

NTS: If material is to be spoiled on Owner's property edit below to suit.

* + 1. Materials removed from the excavations which do not conform to the requirements for fill or are in excess of that required for backfill shall be hauled away from the Site by Contractor and disposed of in compliance with ordinances, codes, Laws and Regulations, at no additional cost to the Owner.
		2. Contractor shall notify Owner in writing of all offsite locations for the disposal of excavated material.

NTS: Insert at (--1--) disposal of known contaminated soil. Coordinate with unit price in measurement and payment.

* + 1. (--1--).

NTS: Coordinate areas designated pavement in the specifications with the drawings.

* + 1. Pavement, gutters, curbs, sidewalks, driveways or roadways disturbed or damaged by Contractor operations, except in areas designed as proposed Work, shall be restored by Contractor at his own expense to a condition equal to or greater than they were previous to the commencement of the Work and in accordance with applicable local and state highway Specifications or requirements.

NTS: Based on project specific requirements add in requirements for preconsolidation, piezometers, and environmental protection and restoration.

NTS: Insert at (--1--) specifications, if any, under this article for all regulatory requirements for work such as submission of plan, prohibited procedures, access roads, storage, watercourse crossings, slopes, wetlands work, protections, restorations, photographs, etc. Delete Article “3.17” if not required as determined by regulatory agency.

* 1. ENVIRONMENTAL PROTECTION AND RESTORATION
		1. (--1--).

+ + END OF SECTION + +