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ARCHITECTS ENGINEERS

FB&T ARENA AND SJM ADDITIONS  
AND RENOVATIONS – BID PACKAGE 01

SOUTH DAKOTA STATE UNIVERSITY  
1165 JACKRABBIT AVE.  
BROOKINGS, SOUTH DAKOTA

DATE  NUMBER	March 01, 2022
	EAPC Project 20191170 OSE# R0319--23X/FBT SDSU WO#22-103751

SET NUMBER	
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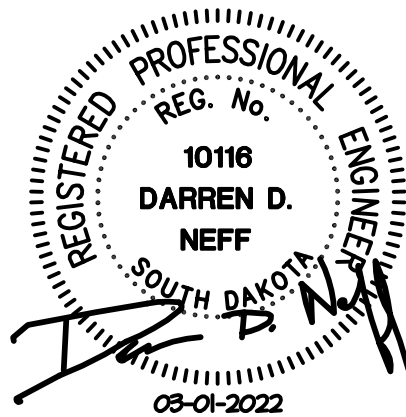
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## SECTION 00 2000 – INFORMATION AVAILABLE TO BIDDERS

### 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.

#### 1.2 SUMMARY

- A. Section includes Existing Reports and Surveys.

#### 1.3 SUBSURFACE EXPLORATION REPORT

- A. A copy of the Soil Boring Logs with respect to this building site is attached to the end of this Section.
  - 1. Title: Soil Boring Logs
  - 2. Date: September 20, 2019
  - 3. Prepared by: GeoTek Engineering & Testing Services, Inc. Sioux Falls, SD
- B. This report, by its nature, cannot reveal all conditions that exist at the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction may need to be made, with resulting credits or expenditures of the Contract Price to the Owner.

### PART 2 - PRODUCTS (Not Applicable)

### PART 3 - EXECUTION (Not Applicable)

END OF SECTION 00 2000



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September 20, 2019

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Attn: Brandon Carda, EI

Subj: Geotechnical Exploration  
Proposed Additions – Phase II  
Stanley Marshall Center  
South Dakota State University  
Brookings, South Dakota  
OSE #R0319--23X  
GeoTek #19-C45

This correspondence presents our written report of the geotechnical exploration program for the referenced project. Our work was performed in accordance with your authorization. We are transmitting an electronic copy of our report for your use. Additional electronic copies are being sent as noted below.

We thank you for the opportunity of providing our services on this project and look forward to continued participation during the design and construction phases. If you have any questions regarding this report, please contact our office at (605) 335-5512.

Respectfully Submitted,  
GeoTek Engineering & Testing Services, Inc.

*Brennen Ahlers*

Brennen Ahlers, PE  
Project Manager

Cc: SDSU Facilities & Services, Attn: Reed Leibel  
EAPC Architects Engineers, Attn: Shawn Crowley, AIA  
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**GEOTECHNICAL EXPLORATION  
PROPOSED ADDITIONS – PHASE II  
STANLEY MARSHALL CENTER  
SOUTH DAKOTA STATE UNIVERSITY  
BROOKINGS, SOUTH DAKOTA  
GEOTEK #19-C45**

**INTRODUCTION**

**Project Information**

This report presents the results of the recent geotechnical exploration program for phase II of the additions to the Stanley Marshall Center in Brookings, South Dakota.

**Scope of Services**

Our work was performed in accordance with our contractual agreement with the Office of State Engineer. The scope of work as presented in this report is limited to the following:

1. To perform four (4) standard penetration test (SPT) borings to gather data on the subsurface conditions at the site. In addition, for informational purposes, we will provide test borings 1, 2 and 3 from the geotechnical exploration report that was dated June 19, 2017 (GeoTek #17-665). These borings were performed as part of Phase I of the Stanley Marshall Center additions.
2. To perform laboratory tests that include moisture content, dry density, Atterberg limits (liquid and plastic limits) and unconfined compressive strength.
3. To prepare an engineering report that includes the results of the field and laboratory tests as well as our earthwork and foundation recommendations for design and construction.

The scope of our work was intended for geotechnical purposes only. This scope of work did not include determining the presence or extent of environmental contamination at the site or to characterize the site relative to wetlands status.

## **SITE & SUBSURFACE CONDITIONS**

### **Site Location & Description**

The site is located on the campus of South Dakota State University in Brookings, South Dakota. The current site features include the following: the existing Stanley Marshall Center, lawn/landscaping areas, trees, sidewalks and light poles. The building additions will be located on the east side and west side of the existing Stanley Marshall Center and between the building that was constructed during Phase I of the project.

### **Ground Surface Elevations & Test Boring Locations**

The ground surface elevations at the test boring locations were determined by using the finished floor of the existing Stanley Marshall Center as a benchmark. An arbitrary elevation of 100.0 feet was used for the benchmark. Based on the benchmark datum, the ground surface elevations at the test boring locations varied from 98.5 feet at test boring 2 to 99.5 feet at test boring 3. The elevations at the previous test borings 1, 2 and 3 were 99.4 feet at test boring 2 and 99.5 feet at test boring 1 and 3 at the time the test borings were performed. A site map is attached at the conclusion of this report showing the relative location of the test borings and benchmark.

### **Subsurface Conditions**

Four (4) test borings were performed at the site on August 8 and August 9, 2019. In addition, 3 previous test borings were performed on June 13, 2017 and are included in the appendix. The subsurface conditions encountered at the test boring locations are illustrated by means of the boring logs included in the appendix.

The subsurface profile at the test boring locations consisted of the following layers: existing fill materials, fine alluvium soils and glacial till soils. At the previous test borings and new test borings, the existing fill materials were encountered at the surface and extended to depths varying from 2 feet to 7 feet. Fine alluvium soils were encountered at new test boring 4, beneath the existing fill materials, and extended to a depth of 4 ½ feet. The glacial till soils were encountered beneath the existing fill materials and fine alluvium soils and extended to the termination depth of the test borings.

The existing fill materials consisted of lean clay soils. The fine alluvium soils consisted of lean clay soil. The glacial till soils consisted of fat clay soils and lean clay with sand soils.

The consistency or relative density of the soils is indicated by the standard penetration resistance (“N”) values as shown on the boring logs. A description of the soil consistency or relative density based on the “N” values can be found on the attached Soil Boring Symbols and Descriptive Terminology data sheet.

We wish to point out that the subsurface conditions at other times and locations at the site may differ from those found at our test boring locations. If different conditions are encountered during construction, then it is important that you contact us so that our recommendations can be reviewed.

### **Water Levels**

Groundwater measurements were not made at the new test borings due to the presence of drilling fluid that was used to advance the deep test borings. Groundwater was measured at a depth of 8 feet at the previous test boring 2 (GeoTek #17-665) at the time the test boring was performed. Groundwater did not enter previous test borings 1 and 3 at the time of our measurements.

The water levels indicated on the boring logs may or may not be an accurate indication of the depth or lack of subsurface groundwater. The limited length of observation restricts the accuracy of the measurements. Long term groundwater monitoring was not included in our scope of work.

## **ENGINEERING REVIEW & RECOMMENDATIONS**

### **Project Design Data**

We understand that the phase II of the project will consist of constructing three (3) building additions to the existing Stanley Marshall Center. An addition was constructed south of the existing Stanley Marshall Center in 2018. The new additions will be located on the west, east and south sides of the Stanley Marshall Center. The west addition will consist of 3-story slab-on-grade addition. The east addition will consist of a new entrance. The new entrance will have a stairwell and an elevator. The south addition will fill in the area between the addition constructed

during Phase I to the existing Stanley Marshall Center (Frost Arena). The east and south additions will be two-story additions. We assume that the finished floor elevations will match the main finished floor of the existing Stanley Marshall Center. The additions will also consist of providing additional seating in Frost Arena. Due to limited space for construction, the use of helical piers is expected in some areas. We understand that maximum wall loads will be on the order of 10 kips per lineal foot (klf) and maximum column loads will be on the order of 280 kips. We anticipate light floor loads within the additions.

The information/assumptions detailed in this section of the report are important factors in our review and recommendations. If there are any corrections or additions to the information detailed in this section, then it is important that you contact us so that we can review our recommendations with regards to the revised plans.

### **Discussion**

The test borings indicate that existing fill materials extended to depths varying from 2 feet to 6 feet. It is our opinion that the existing fill materials are not suitable for support of the footings of the proposed additions. In regards to the fine alluvium soils, it is our opinion that the fine alluvium soils are not suitable for support of the footings of the proposed additions. Regarding floor slab support, the existing fill materials could be considered for indirect support. We have provided 2 site preparation options in the floor slab areas.

In our opinion, the glacial till soils have moderate to high strength characteristics. The upper portion of the glacial till soils have moderate strength characteristics while the lower portion of the glacial till soils have high strength characteristics. With that said, due to the magnitude of the loads, we recommend that some additional site preparation be performed in order to provide uniform support for the footings. The additional site preparation consists of overexcavating to a predetermined depth below the footings and backfilling with granular structural fill or crushed drainage rock. The magnitude of the foundation loads will determine the additional site preparation.

## **Site Preparation – Footing Areas**

### **Wall Loads $\leq$ 10 KLF & Column Loads $\leq$ 150 Kips**

The initial site preparation in the footing areas where the wall loads are less than or equal to 10 klf and column loads are less than or equal to 150 kips should consist of removing the existing fill materials and fine alluvium soils in order to expose the glacial till soils. Following the removals, we recommend further excavating to a minimum depth of at least 2 feet below the bottom-of-footing elevation. This procedure should be followed by placing and compacting granular structural fill up to the design elevations. The overexcavations may extend to a greater depth if the existing fill materials and fine alluvium soils are not completely removed.

### **Wall Loads $>$ 10 KLF & Column Loads $>$ 150 Kips**

The initial site preparation in the footing areas where the wall loads are greater than 10 klf and column loads are greater than 150 kips should consist of removing the existing fill materials and fine alluvium soils in order to expose the glacial till soils. Following the removals, we recommend further excavating to a minimum depth of at least 3 feet below the bottom-of-footing elevation. This procedure should be followed by placing and compacting granular structural fill up to the design elevations. The overexcavations may extend to a greater depth if the existing fill materials and fine alluvium soils are not completely removed.

### **Groundwater & Saturated Soils**

If water or saturated soils are encountered at the bottom of an excavation, then we recommend placing a layer (6 inches to 12 inches) of crushed drainage rock at the bottom of the excavation prior to the placement of the granular structural fill or footings.

### **Lateral Overexcavation**

Where granular structural fill or crushed drainage rock is needed below the footings, the bottom of the excavations should be laterally oversized 1 foot beyond the edges of the footings for each vertical foot of granular structural fill or crushed drainage rock needed below the footings (1 horizontal : 1 vertical).

### **Foundation Loads & Settlement**

If our site preparation recommendations are followed, then it is our opinion that the footings can be sized for a net allowable soil bearing pressure of up to 4,000 psf. We estimate that total settlement of the footings should be less than 1 inch and differential settlement should be less than ½ inch. At least a portion of the anticipated total settlement may appear as differential with respect to the existing building. Unknown soil conditions at the site that are different from those depicted at the test boring locations could increase the amount of expected settlement.

### **Helical Piers**

We understand that helical piers will be used to support some of the foundations of phase II of the Stanley Marshall Center additions. The helical piers should extend down to competent soils (glacial till soils). We recommend that the helical piers be designed by a licensed professional engineer specializing in the design of helical piers. The designer will typically provide a capacity and estimated settlements. The helical piers should be installed by an experienced contractor. Testing of the helical piers should be performed to confirm the design capacities. The helical piers could also be used to support the light foundation loads. A deep test boring was performed for the design of the helical piers. In our opinion, helical piers will likely be needed to support the new columns within the existing building.

### **Coefficient of Friction**

A friction factor of 0.45 can be used between the crushed drainage rock or granular structural fill and the bottom of the concrete. The friction value is considered an ultimate value. We recommend applying a theoretical safety factor of at least 2.0.

### **Site Preparation – Floor Slabs**

It is our opinion that two (2) options can be considered for site preparation in the floor slab areas. If the floor loads are light and the risk for some movement of the floor slab can be accepted by the owner, then it is our opinion that the existing fill materials can be considered for indirect support of the floor slab. This alternative would consist of excavating to a minimum depth of 18 inches below the bottom-of-floor elevation. In addition, all vegetation, pavements and sidewalks

should be removed. Following the removals, we recommend compacting the exposed subgrade with a large sheepsfoot roller. The vibrator should be turned off next to the existing structure to minimize disturbance to the existing structure. We also recommend that observations and testing be performed on the materials exposed at the bottom of the excavation. Unstable areas or areas having low density will likely require further excavation. Once the subgrade is approved, granular structural fill should be placed and compacted up to the design grade. Again, if this option is chosen, the owner will assume some risk of floor slab distress due to potential settlement of the existing fill materials that are left in-place.

However, if the floor loads are heavy or the performance of the floor slab is critical, then we recommend that the site preparation consist of removing the existing fill materials in order to expose the fine alluvium soils and/or glacial till soils. Following the excavation process, we recommend placing and compacting granular structural fill up to the bottom-of-floor elevation.

With both alternatives, we recommend that the final 6 inches of fill beneath the floor slabs consist of select granular fill.

### **Floor Slab – Design**

If our recommendations are followed during site preparations, then it is our opinion that the floor slab can be designed using a soil modulus of subgrade reaction (k value) of 75 psi/inch.

### **Existing Utilities**

We are unaware if any existing utilities area located within the footprint of the proposed additions. If existing utilities are located within the footprint of the proposed additions, then we recommend removing and rerouting any utilities around the building additions.

### **Excavation**

All excavations within the footprint of the building addition should be performed with a track backhoe with a smooth edge bucket. The soils are susceptible to disturbance and can experience strength loss caused by construction traffic and/or additional moisture.

If an excavation adjacent to the existing structure is to extend below the existing foundations, then we recommend that the excavation extend 1 foot to 2 feet outside the bottom of the existing foundation and then extend downward and outward at a slope no steeper than 1:1 (horizontal to vertical). This may not apply if caving soils are encountered beneath the existing foundations. In this case, temporary shoring or underpinning may be needed.

Temporary shoring may also be needed where the building addition connects to the existing structure. Helical piers could also be used if an excavation for a footing cannot be safely performed next to the existing structure. Deeper test borings would likely be needed for the design of the helical piers.

We recommend extreme caution be exercised while excavating adjacent to the existing structure to prevent undermining of the existing foundations. The excavation adjacent to the existing structure should be performed in small sections such that only a limited area of the foundation soils supporting the existing structure is exposed for a short period of time.

### **Below-Grade Retaining Walls**

If there are any below-grade or retaining walls, then we recommend that the below-grade and retaining walls be designed to resist at-rest lateral earth pressures. The backfill materials placed against these walls exert lateral forces on the walls. In order to minimize these lateral forces and to optimize drainage, we recommend using free-draining sand for backfill. The zone of sand backfill should extend a minimum of 2 feet outside the bottom of the wall and then extend upward and outward at a slope no steeper than 1:1 (horizontal to vertical). A tabular listing of the equivalent fluid unit weight values for design of the below-grade and retaining walls is shown in Table 2. Lateral pressures will be significantly higher if the walls are backfilled with soils other than the free-draining sand or if they are not drained and become saturated. We recommend capping the sand backfill section with 1 foot or 2 feet of clayey soil in areas that will not have asphalt or concrete surfacing to minimize infiltration of surface waters.

**Table 1. Equivalent Fluid Unit Weight Values**

Soil Type	At-Rest, pcf		Active, pcf		Passive, pcf	
	Drained	Submerged	Drained	Submerged	Drained	Submerged
Lean Clay	-	-	-	-	220*	115*
Free-Draining Sand (SP)	50	90	35	80	460*	230*

\*Value below frost depth – 0 pcf above frost depth

The passive resistance in front of a below-grade or retaining wall should not be used in an analysis unless the wall extends well below the depth of frost penetration due to loss of strength upon thawing. In addition, development of passive lateral earth pressure in the soil in front of a wall requires a relatively large rotation or outward displacement of the wall. Therefore, we do not recommend using passive resistance in front of the wall for the analysis.

During backfill operations, bracing and/or shoring of the walls may be needed. Only hand-operated compaction equipment should be used directly adjacent to the walls. Prior to backfilling, we recommend that damp/waterproofing be applied on the exterior side of the below-grade walls.

### **Drain Tile Recommendations**

In our opinion, drain tile is not needed along the perimeter of the building addition.

### **Frost Protection**

We recommend that all footings be placed at a sufficient depth for frost protection. The perimeter footings for heated buildings should be placed such that the bottom of the footing is a minimum of 4 feet below finished exterior grade. Interior footings in heated buildings can be placed beneath the floor slab. Footings for unheated areas and canopies, or footings that are not protected from frost during freezing temperatures, should be placed at a minimum depth of 5 feet below the lowest adjacent grade.

### **Material Types & Compaction Levels**

**Granular Structural Fill** – The granular structural fill should consist of a pit-run or processed sand or gravel having a maximum particle size of 3 inches with less than 15 percent by weight passing the #200 sieve.

**Crushed Drainage Rock** – The crushed drainage rock should be washed and meet the gradation specifications shown in Table 2.

**Table 2. Crushed Drainage Rock Gradation Specifications**

<b>Sieve Size</b>	<b>Percent Passing</b>
1 ½-inch	100
1-inch	70 – 90
¾-inch	25 – 50
3/8-inch	0 – 5

**Select Granular Fill** – The select granular fill should consist of a medium to coarse grained, free-draining sand or rock having a maximum particle size of 1 inch with less than 5 percent by weight passing the #200 sieve.

**Free-Draining Sand** – The free-draining sand should have a maximum particle size of 1 inch with less than 5 percent by weight passing the #200 sieve. The exterior foundation wall backfill for below-grade walls should consist of free-draining sand. In areas that will not have asphalt or concrete surfacing, we recommend capping the free-draining sand with at least 1 foot to 2 feet of clay soils to minimize the infiltration of surface water.

**Recommended Compaction Levels** – The recommended compaction levels listed in Table 3 are based on a material's maximum dry density value, as determined by a standard Proctor (ASTM: D698) test.

**Table 3. Recommended Compaction Levels**

<b>Placement Location</b>	<b>Compaction Specifications</b>
Below Footings	100%
Below Floor Slabs	95%
Behind Below-Grade & Retaining Walls	95% - 98%
Exterior Foundation Wall Backfill	95%
Non-Structural Areas	90%

Note: Compaction specifications are not applicable with the drainage rock.

**Recommended Moisture Levels** – The moisture content of the clay backfill materials, when used as backfill around the exterior of a foundation should be maintained within a range of plus 1 percent to minus 4 percent of the materials' optimum moisture content. When the clay backfill materials are used below a pavement area, or as site grading, the materials' moisture content should be maintained within a range of minus 1 percent to minus 4 percent of the materials' optimum moisture content. The optimum moisture content should be determined using a standard Proctor (ASTM: D698) test.

The moisture content of the granular backfill materials should be maintained at a level that will be conducive for vibratory compaction.

**Recommended Lift Sizes** – Typically, as backfill is placed, the loose lift thickness should not exceed 8 inches for granular structural backfill or 6 inches for clay backfill material. Lift sizes may be increased if the equipment used for compaction is large enough to fully compact a thicker lift.

### **Seismic Site Classification**

Based on the 2018 International Building Code (IBC), it is our opinion that the site, as a whole, corresponds to a Site Class D (stiff soil). Also, the ground acceleration values are as follows:  $S_s = 0.088$  g,  $S_1 = 0.026$  g,  $S_{MS} = 0.140$  g,  $S_{M1} = 0.063$  g,  $S_{DS} = 0.094$  g,  $S_{D1} = 0.042$  g. Therefore, the seismic design category is "A". The ground acceleration values are based on the ASCE 7-16 (referenced standard for 2018 IBC) with Risk Category III. If needed, we can provide ground acceleration values for a different design code.

### **Drainage**

Proper drainage should be maintained during and after construction. The general site grading should direct surface run-off waters away from the excavations. Water which accumulates in the excavations should be removed in a timely manner.

Finished grades around the perimeter of the structure should be sloped such that positive drainage away from the structure is provided. Also, a system to collect and channel roof run-off waters away from the structure is suggested.

## **CONSTRUCTION CONSIDERATIONS**

### **Groundwater & Surface Water**

Water may enter the excavations due to subsurface water, precipitation or surface run off. Any water that accumulates in the bottom of the excavations should be immediately removed and surface drainage away from the excavations should be provided during construction.

### **Disturbance of Soils**

The soils encountered at the test boring locations are susceptible to disturbance and can experience strength loss caused by construction traffic and/or additional moisture. Precautions will be required during earthwork activities in order to reduce the risk of soil disturbance.

### **Cold Weather Precautions**

If site preparation and construction is anticipated during cold weather, we recommend all foundations, slabs and other improvements that may be affected by frost movements be insulated from frost penetration during freezing temperatures. If filling is performed during freezing temperatures, all frozen soils, snow and ice should be removed from the areas to be filled prior to placing the new fill. The new fill should not be allowed to freeze during transit, placement and compaction. Concrete should not be placed on frozen subgrades. Frost should not be allowed to penetrate below the footings. If floor slab subgrades freeze, we recommend the frozen soils be removed and replaced, or completely thawed, prior to placement of the floor slab. The subgrade

soils will likely require reworking and recompacting due to the loss of density caused by the freeze/thaw process.

### **Excavation Sideslopes**

The excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, “Excavations and Trenches”. This document states that the excavation safety is the responsibility of the contractor. Reference to this OSHA requirement should be included in the project specifications.

### **Observations & Testing**

This report was prepared using a limited amount of information for the project and a number of assumptions were necessary to help us develop our conclusions and recommendations. It is recommended that our firm be retained to review the geotechnical aspects of the final design plans and specifications to check that our recommendations have been properly incorporated into the design documents.

The recommendations submitted in this report have been made based on the subsurface conditions encountered at the test boring locations. It is possible that there are subsurface conditions at the site that are different from those represented by the test borings. As a result, on-site observation during construction is considered integral to the successful implementation of the recommendations. We believe that qualified field personnel need to be on-site at the following times to observe the site conditions and effectiveness of the construction.

### **Excavation**

We recommend that a geotechnical engineer or geotechnical engineering technician working under the direct supervision of a geotechnical engineer observe all excavations for foundations, slabs and pavements. These observations are recommended to determine if the exposed soils are similar to those encountered at the test boring locations, if unsuitable soils have been adequately removed and if the exposed soils are suitable for support of the proposed construction. These observations should be performed prior to placement of fill or foundations.

### **Testing**

After the subgrade is observed by a geotechnical engineer/technician and approved, we recommend a representative number of compaction tests be taken during the placement of the structural fill and backfill placed below foundations, slabs and pavements, beside foundation walls and behind retaining walls. The tests should be performed to determine if the required compaction has been achieved. As a general guideline, we recommend at least one (1) test be taken for every 2,000 square feet of structural fill placed in building and pavement areas, at least one (1) test for every 75 feet to 100 feet in trench fill, and for every 2-foot thickness of fill or backfill placed. The actual number of tests should be left to the discretion of the geotechnical engineer. Samples of proposed fill and backfill materials should be submitted to our laboratory for testing to determine their compliance with our recommendations and project specifications.

If installed, we recommend that a geotechnical engineer or a geotechnical engineering technician working under the direct supervision of a geotechnical engineer monitor the installation of the helical piers. Detailed records should be kept during installation.

## **SUBSURFACE EXPLORATION PROCEDURES**

### **Test Borings**

The test borings were performed with a truck rig equipped with hollow-stem auger. Soil sampling was performed in accordance with the procedures described in ASTM:D1586. Using this procedure, a 2-inch O.D. split barrel sampler is driven into the soil by a 140-pound weight falling 30 inches. After an initial set of 6 inches, the number of blows required to drive the sampler an additional 12 inches is known as the penetration resistance, or “N” value. The “N” value is an index of the relative density of cohesionless soils and the consistency of cohesive soils. In addition, thin walled tube samples were obtained according to ASTM:D1587, where indicated by the appropriate symbol on the boring logs.

The test borings were backfilled with on-site materials and some settlement of these materials can be expected to occur. Final closure of the holes is the responsibility of the client or property owner.

The soil samples collected from the test boring locations will be retained in our office for a period of one (1) month after the date of this report and will then be discarded unless we are notified otherwise.

### **Soil Classification**

As the samples were obtained in the field, they were visually and manually classified by the crew chief according to ASTM:D2488. Representative portions of all samples were then sealed and returned to the laboratory for further examination and for verification of the field classification. In addition, select samples were then submitted to a program of laboratory tests. Where laboratory classification tests (sieve analysis and Atterberg limits) have been performed, classifications according to ASTM:D2487 are possible. Logs of the test borings indicating the depth and identification of the various strata, the “N” value, the laboratory test data, water level information and pertinent information regarding the method of maintaining and advancing the drill holes are also attached in the appendix. Charts illustrating the soil classification procedures, the descriptive terminology and the symbols used on the boring logs are also attached in the appendix.

### **Water Level Measurements**

Subsurface groundwater levels should be expected to fluctuate seasonally and yearly from the groundwater readings recorded at the test borings. Fluctuations occur due to varying seasonal and yearly rainfall amounts and snowmelt, as well as other factors.

### **Laboratory Tests**

Laboratory tests were performed on select samples to aid in determining the index and strength properties of the soils. The index tests consisted of moisture content, dry density, sieve analysis (#200 sieve wash), standard Proctor, resistivity and Atterberg limits (liquid and plastic limits). The strength tests consisted of unconfined compressive strength. The laboratory tests were performed in accordance with the appropriate ASTM procedures. The results of the laboratory tests are shown on the boring logs opposite the samples upon which the tests were performed or on the data sheets included in the appendix.

### **LIMITATIONS**

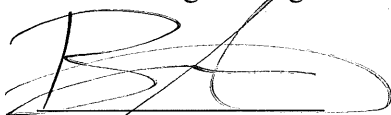
The recommendations and professional opinions submitted in this report were based upon the data obtained through the sampling and testing program at the test boring locations. We wish to point out that because no exploration program can totally reveal the exact subsurface conditions for the entire site, conditions between test borings and between samples and at other times may differ from those described in our report. Our exploration program identified subsurface conditions only at those points where samples were retrieved or where water was observed. It is not standard engineering practice to continuously retrieve samples for the full depth of the borings. Therefore, strata boundaries and thicknesses must be inferred to some extent. Additionally, some soils layers present in the ground may not be observed between sampling intervals. If the subsurface conditions encountered at the time of construction differ from those represented by our test borings, it is necessary to contact us so that our recommendations can be reviewed. The variations may result in altering our conclusions or recommendations regarding site preparation or construction procedures, thus, potentially affecting construction costs.

This report is for the exclusive use of the addressee and its representatives for use in design of the proposed project described herein and preparation of construction documents. Without written approval, we assume no responsibility to other parties regarding this report. Our conclusions, opinions and recommendations may not be appropriate for other parties or projects.

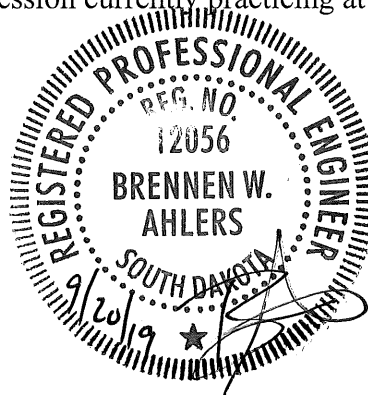
### **STANDARD OF CARE**

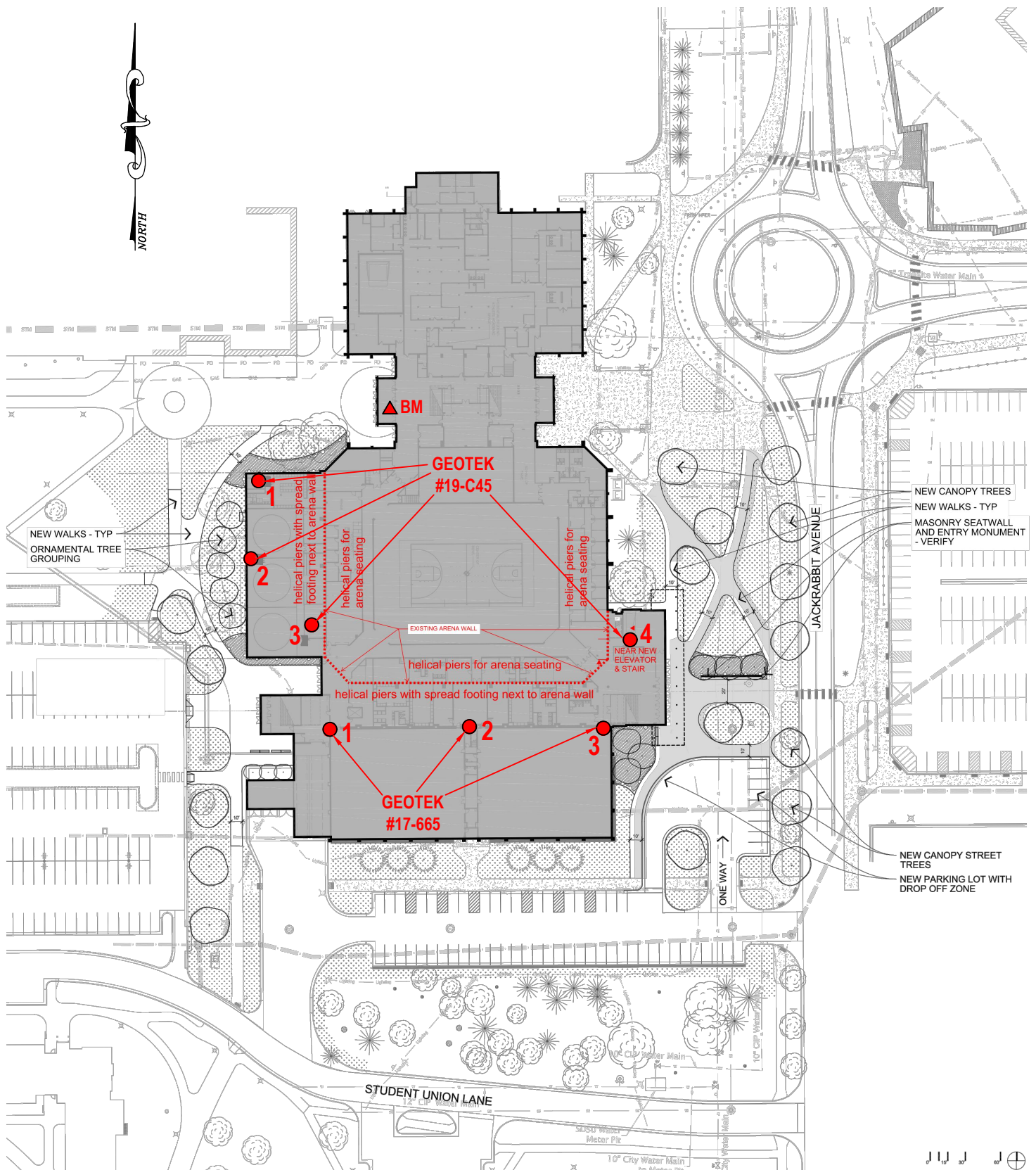
The recommendations submitted in this report represent our professional opinions. Our services for your project were performed in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession currently practicing at this time and area.

This report was prepared by:  
GeoTek Engineering & Testing Services, Inc.



Brennen Ahlers, PE  
Project Manager





SMC - PHASE II  
SDSU



PERKINS+WILL  
SCHEMATIC DESIGN



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# GEOTECHNICAL TEST BORING LOG

GEOTEK # <b>19-C45</b>						BORING NO. <b>1 (1 of 2)</b>					
PROJECT <b>Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD</b>											
DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
	SURFACE ELEVATION <u>98.6 ft</u>										
4 1/2	<b>FILL, MOSTLY LEAN CLAY:</b> dark brown, moist, stiff, 12" of topsoil at the surface	FILL			1	HSA					
			12		2	SPT	12	122			
			6		3	SPT	16	117			
			7		4	SPT	17	111			3400
			7		5	SPT					
			11		6	SPT					
			8		7	SPT	24	103			3800
			11		8	SPT					
WATER LEVEL MEASUREMENTS						START <u>8-8-19</u> COMPLETE <u>8-8-19 11:24 am</u>					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD					
8-8-19	11:27 am	51	--	--	--	Rotary Mud Drilling					
--	--	--	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--	CREW CHIEF Scott Schumacher					

GEOTECHNICAL TEST BORING 19-C45.GPJ GEOTEKENG.GDT 9/20/19



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# GEOTECHNICAL TEST BORING LOG

GEOTEK # <b>19-C45</b>						BORING NO. <b>1 (2 of 2)</b>						
PROJECT <b>Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD</b>												
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>98.6 ft</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	WC	D	LL	PL	QU	
	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown, moist, firm to very stiff, (CL) <i>(Continued from previous page)</i>		12		9	X SPT						
					22	10	X SPT					
39½	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown and dark gray, moist, very stiff, (CL)				16	11	X SPT					
44½	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown, moist, very stiff, (CL)				18	12	X SPT					
51			21		13	X SPT						
	Bottom of borehole at 51 feet.											
WATER LEVEL MEASUREMENTS						START <u>8-8-19</u> COMPLETE <u>8-8-19 11:24 am</u>						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD						
8-8-19	11:27 am	51	--	--	--	Rotary Mud Drilling						
--	--	--	--	--	--							
--	--	--	--	--	--							
--	--	--	--	--	--	CREW CHIEF Scott Schumacher						

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# **GEOTECHNICAL TEST BORING LOG**

GEOTEK # <b>19-C45</b>						BORING NO. <b>2 (1 of 2)</b>					
PROJECT <b>Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD</b>											
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>98.5 ft</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
6	<b>FILL, MOSTLY LEAN CLAY:</b> dark brown, moist, firm, 12" of topsoil at the surface	FILL	7		1	HSA					
					2	SPT	16	117			
	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	6		3	SPT	19				
					4	SPT	19	111			3000
					5	SPT					
					6	SPT					
19½	<b>FAT CLAY:</b> brown, moist, stiff, (CH)	GLACIAL TILL	9		7	SPT	27	100		3800	
24½	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown to dark gray, moist, very stiff, (CL)	GLACIAL TILL	17		8	SPT					
WATER LEVEL MEASUREMENTS						START <u>8-8-19</u> COMPLETE <u>8-8-19 1:46 pm</u>					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD Rotary Mud Drilling					
8-8-19	1:49 pm	51	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--	CREW CHIEF <u>Scott Schumacher</u>					

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# **GEOTECHNICAL TEST BORING LOG**

GEOTEK # <b>19-C45</b>						BORING NO. <b>2 (2 of 2)</b>						
PROJECT <b>Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD</b>												
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>98.5 ft</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	WC	D	LL	PL	QU	
51	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown to dark gray, moist, very stiff, (CL) <i>(Continued from previous page)</i>	GLACIAL TILL	19		9	X	SPT	18	115			9800
			16		10	X	SPT					
			23		11	X	SPT					
			23		12	X	SPT					
			25		13	X	SPT					
Bottom of borehole at 51 feet.												
WATER LEVEL MEASUREMENTS						START <u>8-8-19</u> COMPLETE <u>8-8-19 1:46 pm</u>						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD						
8-8-19	1:49 pm	51	--	--	--	Rotary Mud Drilling						
--	--	--	--	--	--							
--	--	--	--	--	--							
--	--	--	--	--	--	CREW CHIEF Scott Schumacher						

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# **GEOTECHNICAL TEST BORING LOG**

GEOTEK # **19-C45**

BORING NO. **3 (1 of 2)**

PROJECT **Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION    99.5 ft	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
4½  											

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# **GEOTECHNICAL TEST BORING LOG**

GEOTEK # <b>19-C45</b>						BORING NO. <b>3 (2 of 2)</b>							
PROJECT <b>Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD</b>													
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>99.5 ft</u>		GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
						NO.	TYPE	WC	D	LL	PL	QU	
51	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown, moist, very stiff, (CL) <i>(Continued from previous page)</i>		GLACIAL TILL	17		9	X SPT						
						24	10	X SPT					
						24	11	X SPT	19	114		7800	
						24	12	X SPT					
						26	13	X SPT					
Bottom of borehole at 51 feet.													
WATER LEVEL MEASUREMENTS						START <u>8-8-19</u> COMPLETE <u>8-8-19 4:47 pm</u>							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD							
8-8-19	4:53 pm	51	--	--	--	Rotary Mud Drilling							
--	--	--	--	--	--								
--	--	--	--	--	--								
--	--	--	--	--	--	CREW CHIEF Scott Schumacher							

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# **GEOTECHNICAL TEST BORING LOG**

GEOTEK # **19-C45**

BORING NO. **4 (1 of 2)**

PROJECT **Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION    99.3 ft	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
2   <											

GEOTECHNICAL TEST BORING 19-C45.GPJ GEOTEKENG.GDT 9/20/19



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# GEOTECHNICAL TEST BORING LOG

GEOTEK # <b>19-C45</b>						BORING NO. <b>4 (2 of 2)</b>					
PROJECT <b>Proposed Additions - Phase II, Stanley Marshall Center, OSE #R0319--23X, Brookings, SD</b>											
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>99.3 ft</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
	<b>FAT CLAY:</b> a trace of gravel, brown to dark brown, moist, firm to very stiff, (CH) (Continued from previous page)	GLACIAL TILL									
			16	9	X	SPT	18	112			6000
			16	10	X	SPT					
39½	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	13		11	X	SPT				
44½	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, dark brown, moist, very stiff, (CL)	GLACIAL TILL	17		12	X	SPT				
51			19		13	X	SPT				
	Bottom of borehole at 51 feet.										
WATER LEVEL MEASUREMENTS						START <u>8-9-19</u> COMPLETE <u>8-9-19 10:13 am</u>					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD Rotary Mud Drilling					
--	--	--	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--	CREW CHIEF Roy Hanson					

GEOTECHNICAL TEST BORING 19-C45.GPJ GEOTEKENG.GDT 9/20/19



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# GEOTECHNICAL TEST BORING LOG

GEOTEK # <b>17-665</b>						BORING NO. <b>1 (1 of 1)</b>						
PROJECT <b>Proposed Building Addition, Stanley Marshall Center, South Dakota State University, Brookings, SD</b>												
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>99.5 ft</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	WC	D	LL	PL	QU	
7	<b>FILL, MIXTURE OF LEAN CLAY AND SAND:</b> a little gravel, brown and dark brown, moist	FILL	8		1	HSA	16					
					2	SPT	16					
					3	SPT						
					4	SPT						
					5	SPT						
					6	SPT						
					7	SPT						
16	<b>LEAN CLAY WITH SAND:</b> a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	9		4	SPT	18	113			3200	
					5	SPT						
					6	SPT						
					7	SPT						
Bottom of borehole at 16 feet.												
WATER LEVEL MEASUREMENTS						START <u>6-13-17</u> COMPLETE <u>6-13-17 10:45 am</u>						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD						
6-13-17	2:57 pm	16	--	14	none	3.25" ID Hollow Stem Auger						
--	--	--	--	--	--							
--	--	--	--	--	--							
--	--	--	--	--	--	CREW CHIEF Mike Wagner						

GEOTECHNICAL TEST BORING 17-665.GPJ GEOTEKENG.GDT 6/19/17



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# GEOTECHNICAL TEST BORING LOG

GEOTEK # <b>17-665</b>						BORING NO. <b>2 (1 of 1)</b>					
PROJECT <b>Proposed Building Addition, Stanley Marshall Center, South Dakota State University, Brookings, SD</b>											
DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
	↓ SURFACE ELEVATION <u>99.4 ft</u>										
3	<b>FILL, MOSTLY LEAN CLAY WITH SAND:</b> a little gravel, brown and dark brown, moist, 6" of concrete at the surface	FILL			1	HSA					
			10		2	SPT	15				
	<b>LEAN CLAY WITH SAND:</b> a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	12		3	SPT	15	117	38	15	5200
			13	▼	4	SPT					
			14		5	SPT					
			15		6	SPT					
			15		7	SPT					
16	Bottom of borehole at 16 feet.										
WATER LEVEL MEASUREMENTS						START <u>6-13-17</u> COMPLETE <u>6-13-17 10:08 am</u>					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD					
6-13-17	2:52 pm	16	--	8	▼ 8	3.25" ID Hollow Stem Auger					
--	--	--	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--	CREW CHIEF Mike Wagner					

GEOTECHNICAL TEST BORING 17-665.GPJ GEOTEKENG.GDT 6/19/17






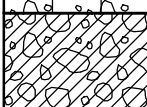


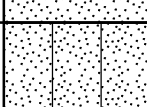


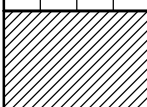
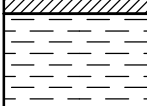
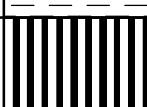
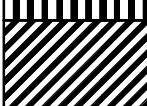
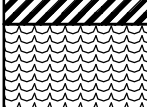
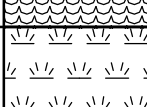
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# **GEOTECHNICAL TEST BORING LOG**

GEOTEK # <b>17-665</b>						BORING NO. <b>3 (1 of 1)</b>					
PROJECT <b>Proposed Building Addition, Stanley Marshall Center, South Dakota State University, Brookings, SD</b>											
DEPTH in FEET	DESCRIPTION OF MATERIAL ↓ SURFACE ELEVATION <u>99.5 ft</u>	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
					NO.	TYPE	WC	D	LL	PL	QU
7	<b>FILL, MOSTLY LEAN CLAY WITH SAND:</b> a little gravel, brown, moist, 6" of concrete at the surface	FILL			1	HSA					
					2	SPT	8	93			
					3	SPT	13	109			
					4	SPT	17	114			
					5	SPT					
					6	SPT					
					7	SPT					
16	<b>LEAN CLAY WITH SAND:</b> a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL			4	SPT	17	114			
					5	SPT					
					6	SPT					
					7	SPT					
Bottom of borehole at 16 feet.											
WATER LEVEL MEASUREMENTS						START <u>6-13-17</u> COMPLETE <u>6-13-17 9:34 am</u>					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD					
6-13-17	2:37 pm	16	--	14	none	3.25" ID Hollow Stem Auger					
--	--	--	--	--	--						
--	--	--	--	--	--						
--	--	--	--	--	--	CREW CHIEF Mike Wagner					

GEOTECHNICAL TEST BORING 17-665.GPJ GEOTEKENG.GDT 6/19/17

# SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS  (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS  MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS  (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS  LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

# BORING LOG SYMBOLS AND DESCRIPTIVE TERMINOLOGY

## SYMBOLS FOR DRILLING AND SAMPLING

<u>Symbol</u>	<u>Definition</u>
Bag	Bag sample
CS	Continuous split-spoon sampling
DM	Drilling mud
FA	Flight auger; number indicates outside diameter in inches
HA	Hand auger; number indicates outside diameter in inches
HSA	Hollow stem auger; number indicates inside diameter in inches
LS	Liner sample; number indicates outside diameter of liner sample
N	Standard penetration resistance (N-value) in blows per foot
NMR	No water level measurement recorded, primarily due to presence of drilling fluid
NSR	No sample retrieved; classification is based on action of drilling equipment and/or material noted in drilling fluid or on sampling bit
SH	Shelby tube sample; 3-inch outside diameter
SPT	Standard penetration test (N-value) using standard split-spoon sampler
SS	Split-spoon sample; 2-inch outside diameter unless otherwise noted
WL	Water level directly measured in boring
▼	Water level symbol

## SYMBOLS FOR LABORATORY TESTS

<u>Symbol</u>	<u>Definition</u>
WC	Water content, percent of dry weight; ASTM:D2216
D	Dry density, pounds per cubic foot
LL	Liquid limit; ASTM:D4318
PL	Plastic limit; ASTM:D4318
QU	Unconfined compressive strength, pounds per square foot; ASTM:D2166

## DENSITY/CONSISTENCY TERMINOLOGY

<u>Density</u>		<u>Consistency</u>
<u>Term</u>	<u>N-Value</u>	<u>Term</u>
Very Loose	0-4	Soft
Loose	5-8	Firm
Medium Dense	9-15	Stiff
Dense	16-30	Very Stiff
Very Dense	Over 30	Hard

## PARTICLE SIZES

<u>Term</u>	<u>Particle Size</u>
Boulder	Over 12"
Cobble	3" – 12"
Gravel	#4 – 3"
Coarse Sand	#10 – #4
Medium Sand	#40 – #10
Fine Sand	#200 – #40
Silt and Clay	passes #200 sieve

## DESCRIPTIVE TERMINOLOGY

<u>Term</u>	<u>Definition</u>
Dry	Absence of moisture, powdery
Frozen	Frozen soil
Moist	Damp, below saturation
Waterbearing	Pervious soil below water
Wet	Saturated, above liquid limit
Lamination	Up to ½" thick stratum
Layer	½" to 6" thick stratum
Lens	½" to 6" discontinuous stratum

## GRAVEL PERCENTAGES

<u>Term</u>	<u>Range</u>
A trace of gravel	2-4%
A little gravel	5-15%
With gravel	16-50%

## SECTION 01 1000 – SUMMARY (Bid Package 01)

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and Drawing conventions.

##### B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.2 PROJECT INFORMATION

##### A. Project Identification: Stanley J. Marshall Center Phase One.

1. Project Location: 1165 Jackrabbit Ave, Brookings, SD 57007.

##### B. Owner: South Dakota State University.

1. Owner's Representative: Reed Leibel
2. Phone: 605.688.5020
3. Email: [Reed.Leibel@sdstate.edu](mailto:Reed.Leibel@sdstate.edu)

##### C. Architect: EAPC Architects Engineers,

1. Contact: Shawn Crowley, AIA
2. Address: 101 N. Phillips Ave Suite 300, Sioux Falls, SD, 57104
3. Phone: 605.444.1600

##### D. Construction Manager: Henry Carlson Construction.

1. Contact: Dave Derry
2. Address: 1205 W. Russell Street, Sioux Falls, SD, 57104
3. Phone: 605.336.2410.

##### E. Web-Based Project Software: Project software administered by Construction Manager will be used for purposes of managing communication and documents during the construction stage.

### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  - 1. Project includes a renovation of the existing Frost Arena and additions to the south and west side of the building to expand wrestling and the concourse respectively. The renovation will include new tiered fixed seating platforms around the perimeter of the court, restrooms, concessions, ADA updates, and overall finish upgrades.
  - 2. Bid Package 01 includes the majority of the building structure which will be constructed using steel columns, beams, joists and decking. In addition, there will be concrete footings/foundations/slabs, helical piers, precast stadia, and other Work indicated in the Contract Documents.
- B. Type of Contract:
  - 1. Project will be constructed under a single prime contract.

### 1.4 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
  - 1. When work is required within the owner-occupied building, contractor shall notify the owner at least 72 hrs. in advance before beginning work.
  - 2. If construction dirt is tracked into owner-occupied areas, contractor shall clean all affected areas within 24 hrs. of the incident as required by the SDSU contractor cleaning standard.

### 1.5 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

### 1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

2. Work with the owner to ensure that work is not conflicting with scheduled events within the arena.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7a.m. to 6p.m., Monday through Friday, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  1. Notify Owner not less than two days in advance of proposed utility interruptions.
- D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.
- E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

#### 1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

## SECTION 01 2500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

- e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Substitution request is fully documented and properly submitted.
  - c. Requested substitution will not adversely affect Contractor's construction schedule.
  - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  - b. Requested substitution does not require extensive revisions to the Contract Documents.
  - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - d. Substitution request is fully documented and properly submitted.
  - e. Requested substitution will not adversely affect Contractor's construction schedule.
  - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - g. Requested substitution is compatible with other portions of the Work.
  - h. Requested substitution has been coordinated with other portions of the Work.
  - i. Requested substitution provides specified warranty.

- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

## SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

#### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form acceptable to OSE.

#### 1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

#### 1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on OSE Change Order Form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

## SECTION 01 2900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### 1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Arrange schedule of values consistent with format of AIA Document G703.
  - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Payment for materials stored off-site will not be approved
  - 4. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
  - 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
  - 6. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  - 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
  - 8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

### 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 25th of the month. The period covered by each Application for Payment is one month, ending on the 24th.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 or other form approved by the owner as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Sustainable design action plans, including preliminary project materials cost data.
  6. Schedule of unit prices.
  7. Submittal schedule (preliminary if not final).
  8. List of Contractor's staff assignments.
  9. List of Contractor's principal consultants.
  10. Copies of building permits.
  11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  12. Initial progress report.
  13. Certificates of insurance and insurance policies.
  14. Performance and payment bonds.
  15. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706.
  5. AIA Document G706A.
  6. AIA Document G707.
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

## SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. RFIs.
  - 3. Digital project management procedures.
  - 4. Project meetings.
- B. Related Requirements:
  - 1. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 2. Section 01 9113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

#### 1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.

## 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.

## 1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Date.
  - 4. Name of Contractor.
  - 5. Name of Architect and Construction Manager.
  - 6. RFI number, numbered sequentially.
  - 7. RFI subject.
  - 8. Specification Section number and title and related paragraphs, as appropriate.
  - 9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect and Construction Manager.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's and Construction Manager's response was received.

- F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.

## 1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Data Files Not Available: Architect will not provide Architect's BIM model digital data files for Contractor's use during construction.
- B. Web-Based Project Software: Use Construction Manager's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
  - 1. Web-based Project software site includes, at a minimum, the following features:
    - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    - c. Document workflow planning, allowing customization of workflow between project entities.
    - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    - e. Track status of each Project communication in real time, and log time and date when responses are provided.
    - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    - g. Processing and tracking of payment applications.
    - h. Processing and tracking of contract modifications.
    - i. Creating and distributing meeting minutes.
    - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    - k. Management of construction progress photographs.
    - l. Mobile device compatibility, including smartphones and tablets.
  - 2. Provide the necessary web-based Project software user licenses for use of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and Architect's consultants.
  - 3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
  - 4. Provide the following web-based Project software packages under their current published licensing agreements:
    - a. Procore Technologies, Inc.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

## 1.8 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority,, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Critical work sequencing and long lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Use of web-based Project software.
    - g. Procedures for processing field decisions and Change Orders.
    - h. Procedures for RFIs.
    - i. Procedures for testing and inspecting.
    - j. Procedures for processing Applications for Payment.
    - k. Distribution of the Contract Documents.
    - l. Submittal procedures.
    - m. Sustainable design requirements.
    - n. Preparation of Record Documents.
    - o. Use of the premises and existing building.
    - p. Work restrictions.
    - q. Working hours.
    - r. Owner's occupancy requirements.
    - s. Responsibility for temporary facilities and controls.
    - t. Procedures for disruptions and shutdowns.
    - u. Construction waste management and recycling.
    - v. Parking availability.
    - w. Office, work, and storage areas.
    - x. Equipment deliveries and priorities.
    - y. First aid.
    - z. Security.
    - aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Progress Meetings: Construction Manager will conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Status of sustainable design documentation.
      - 5) Deliveries.
      - 6) Off-site fabrication.
      - 7) Access.
      - 8) Site use.
      - 9) Temporary facilities and controls.
      - 10) Progress cleaning.
      - 11) Quality and work standards.
      - 12) Status of correction of deficient items.
      - 13) Field observations.
      - 14) Status of RFIs.
      - 15) Status of Proposal Requests.
      - 16) Pending changes.
      - 17) Status of Change Orders.
      - 18) Documentation of information for payment requests.
  4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

## SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Site condition reports.

#### 1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
  1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
  2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
  3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.

#### 1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  1. Secure time commitments for performing critical elements of the Work from entities involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

#### 1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
  1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  5. Commissioning Time: Include no fewer than 15 days for commissioning.
  6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
  7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  2. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Use-of-premises restrictions.
    - e. Provisions for future construction.
    - f. Seasonal variations.
    - g. Environmental control.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
  2. Unanswered Requests for Information.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At bi-monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule two days before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

#### 1.6 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

#### 1.7 REPORTS

- A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3200

## SECTION 01 3300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

#### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

#### 1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.

10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  1. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Resubmittal Review: Allow 15 days for review of each resubmittal.

- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.

- f. Relationship and attachment to adjoining construction clearly indicated.
  - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  - 3. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
  - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
  2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

#### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  1. Submittals by Web-Based Project Software: Architect will indicate, on Project software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3300

## SECTION 01 4000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

### 1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## 1.5 ACTION SUBMITTALS

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspecting.

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Statement on condition of substrates and their acceptability for installation of product.
  2. Statement that products at Project site comply with requirements.
  3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
  2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  3. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - d. When testing is complete, remove test specimens and test assemblies, mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  3. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
  4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  5. Demonstrate the proposed range of aesthetic effects and workmanship.
  6. Coordinate with any 3<sup>rd</sup> party testing agencies to perform required testing on the assembly.

7. Obtain Architect's and Construction Manager's approval of mockups before starting corresponding work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  9. Demolish and remove mockups when directed unless otherwise indicated.
- L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least 24 hours in advance of time or sooner as determined at the preconstruction meeting when Work that requires testing or inspection will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, , Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  6. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, , Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and Construction Manager's reference during normal working hours.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

## SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

#### 1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in ICC/ANSI A117.1.

#### 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

### PART 2 - PRODUCTS

#### 2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
  3. Drinking water and private toilet.
  4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

## 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction[.] and clean HVAC system as required in Section 01 7700 "Closeout Procedures."
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
  - 1. Contractor to furnish and install an approved backflow prevention device at all construction site water connections.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service underground unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
  - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
  - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  - 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 7300 "Execution."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Elevator Use: Use of elevators is not permitted. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. When specified, fencing must enclose all areas of the site such that no area of the construction is accessible to pedestrians or unauthorized personnel or vehicles. Access points must be clearly defined and include a means to limit access to the site and prevent inadvertent entry. Fencing must be continuously maintained in a neat and orderly condition.
  - 3. Security and safety should be considered in determining the fence type. Where security

4. of site installations is required, chain link fence should always be used regardless of the duration or level of hazard. Additional adjustments to the standard (fence height, etc.) should be considered as appropriate to the security risk.
  5. Chain Link fence:
    - a. Six feet (6.0') high with galvanized steel pipe posts.
    - b. Gates shall be provided to control all access points. Hinged and lockable.
    - c. Installations must use a top and bottom tension wire or a top rail may be used in place of the top tension wire.
  6. Fencing installed on paved areas may be self-supported or posts may be driven thru the pavement.
    - a. Self-supported fence must include a stable support system that discourages movement or topping of the fence.
    - b. Pavement penetrations will require a concrete hole patch when the posts are removed.
  7. Warning signs shall be installed on fencing spaced no more than 50 feet apart with at least one on each side of the site that read "Danger – Construction Area – No Entry – Authorized Personnel Only". Signs must be professionally prepared and sign material must be suitable to withstand outdoor weather conditions for the duration of construction. Signs must be easily readable from a distance of 20 feet
  8. Where fencing is installed across existing walkways or roadways, retro reflective or lighted visual barriers and appropriate "Sidewalk Closed" or "Road Closed" signage shall be provided. All signage for closures of public streets and roadways must comply with the Manual on Uniform Traffic Control Devices for Streets and Highways.
  9. Where fencing is located adjacent to a roadway or walkway that is to remain in use,
  10. fencing shall be set back a minimum of 3 feet where possible to allow for snow removal activities.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
  2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  3. Provide walk-off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.

3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.
  6. Discard and replace stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

## **SECTION 01 5713**

### **TEMPORARY EROSION AND SEDIMENT CONTROL**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. This Section includes erosion and sediment control to minimize pollution into waterways, drainage ditches, and storm and sanitary sewer systems due to construction activities

##### **1.02 REFERENCES**

- A. U.S. Environmental Protection Agency (EPA), National Pollution Discharge Elimination System (NPDES).
- B. South Dakota Department of Agriculture and Natural Resources (SD DANR), General Permit for Storm Water Discharges Associated with Construction Activities.
- C. South Dakota Department of Transportation (SDDOT) Standard Specifications for Roads & Bridges, 2015 Edition, including all subsequent revisions.
- D. South Dakota State University Design Standards.

##### **1.03 SUBMITTALS**

- A. Submit product data and technical information on the following items:
  - 1. Silt Fence Fabric.
  - 2. Erosion Control Wattles.
  - 3. Erosion Control Blankets.
  - 4. Other erosion control items included in this section.

##### **1.04 REQUIRED DOCUMENTS**

- A. Storm Water Pollution Prevention Plan
  - 1. Required on all projects that disturb more than 1 acre.
  - 2. See SWPPP included in the Drawings or provide SWPPP if not included.
  - 3. The SWPPP is a joint effort and responsibility of the Contractor and Owner.
  - 4. Erosion control measures and best management practices will be implemented in accordance with the SWPPP.
  - 5. The SWPPP is a dynamic document that shall be updated by the Contractor as necessary to meet local & state requirements and shall be available on-site at all times.
  - 6. Contractor or their certified Erosion Control Supervisor is responsible for complying with effluent limits in accordance with the General Permit, Section 3.0.
  - 7. Contractor or their certified Erosion Control Supervisor must maintain and update a site map in accordance with the General Permit, Section 5.3.4.
- B. Erosion Control Plan

1. If there is an erosion control plan included in the Drawings, it is the minimum required for completion of the project. The Contractor is responsible for all items required per this specification.
  2. The Contractor is responsible for determining and providing erosion control as needed to establish permanent vegetation. This may include additional erosion control blanket or wattles along the flow paths or in areas with slopes greater than 6:1.
  3. There shall be no claims for additional payment for attendance of inspections, responses, or additional items required by SDDANR representatives.
  4. The erosion control plan shall be updated and maintained by the Contractor in conformance with the SWPPP and general permit throughout the duration of the construction.
  5. All inspections, inspection reports and other documentation are the responsibility of the Contractor.
- C. Contractor Certification Form
1. The "Department of Agriculture and Natural Resources - Contractor Certification Form" (SD EForm - 2110LDV1) shall be completed by the Contractor or their certified Erosion Control Supervisor after the award of the contract.
  2. Work may not begin on the project until this form is signed.
  3. The form certifies under penalty of law that the Contractor understands and will comply with the terms and conditions of the Surface Water Discharge General Permit for Storm Water Discharges Associated with Construction Activities for the Project.
  4. The form can be found online.
- D. Notice of Intent (NOI)
1. A Notice of Intent (NOI) must be submitted to the SD DANR a minimum of 15 days prior to project start.
  2. A letter must be received from the DANR that acknowledges project coverage under the general permit before project start.
  3. The Contractor is advised that permit coverage may also be required by off-site activities, such as borrow and staging areas, which are the responsibility of the Contractor.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. General: Comply with all requirements of SD DANR and the City of Brookings for erosion and sediment control.
- B. Comply with the requirements of the Storm Water Pollution Prevention Plan, included in the Drawings.

### **2.02 SILT FENCE FABRIC & POSTS**

- A. Conform to Section 734 of the SD DOT Standard Specifications.
- B. Reference SD DOT Standard Plate 734.05 for Details.

- C. Fabric: Must be from the SD DOT Approved Project list for high flow silt fence.
- D. Posts: Steel T line posts – 5-foot minimum length

#### 2.03 EROSION CONTROL WATTLES

- A. Conform to Section 734 of the SD DOT Standard Specifications.
- B. Reference SD DOT Standard Plate 734.06 for Details.
- C. Must be from the SD DOT Approved Products list.
- D. Weed-free straw, excelsior, or coconut husk, with biodegradable netting.
- E. Anchors: Wooden or other biodegradable stakes.

#### 2.04 EROSION CONTROL BLANKET

- A. Conform to Section 734 of the SD DOT Standard Specifications.
- B. Reference SD DOT Standard Plate 734.01 for Details.
- C. Must be from the SD DOT Approved Products list.

#### 2.05 SEDIMENT CONTROL AT INLETS

- A. Conform to Section 734 of the SD DOT Standard Specifications.
- B. Reference SD DOT Standard Plate 734.10 and 734.11 for Details.

#### 2.06 TEMPORARY CONSTRUCTION ENTRANCE

- A. Conform to the details included in the Drawings.
- B. 1-1/2" to 3" clean rock.
- C. Minimum Thickness of Rock: 6 inches.
- D. Minimum Length of Rock: 50 feet.

#### 2.07 CONCRETE WASHOUT FACILITY (CWF)

- A. Conform to the details included in the Drawings.
- B. Concrete trucks shall washout in the designated CWF only.

### **PART 3 EXECUTION**

#### 3.01 GENERAL

- A. Conform to SD DOT Standard Specifications, applicable SD DOT Standard Plates and details included in the Drawings.

#### 3.02 INSPECTIONS

- A. Contractor or their certified Erosion Control Supervisor is responsible for conducting and documenting site inspections as required by the General Permit.
- B. Site inspections must occur at the following minimum frequencies:
  - 1. Once every 7 calendar days; and
  - 2. Within 24 hours of precipitation that exceeds 0.25 inches or snowmelt that generate runoff. An accurate and properly maintained rain gauge shall be kept onsite.

### 3.03 SILT FENCE FABRIC AND POSTS

- A. Install in accordance with SD DOT Standard Plate 734.05.
- B. Install in locations shown in plans and at locations that will minimize siltation of adjacent streams, lakes, dams or drainage areas.
- C. Install around temporary stockpiles to control sediment.
- D. Install around perimeter of the site.
- E. Remove trapped sediment from the silt fence (mucking).
- F. Silt fence may be removed after vegetation is established, which may require leaving the silt fence in place after all other work is completed.
- G. Maintain silt fence in conformance with the SWPPP and SD DOT Specifications.
- H. Inspect and repair silt fence throughout the duration of the project, and as required by the SWPPP.

### 3.04 EROSION CONTROL WATTLES

- A. Install in accordance with SD DOT Standard Plate 734.06.
- B. Install perpendicular to flow across the bottom of existing and new drainage channels or swales within the project area.
- C. Spacing shall be as indicated on the SD DOT Standard Plate.
- D. Maximum spacing along ditches shall be 200 feet for slopes less than 1%.
- E. Install in locations of concentrated flow and as needed to prevent erosion.

### 3.05 SEDIMENT CONTROL AT INLETS

- A. Install in accordance with SD DOT Standard Plate 734.10 or 734.11 as applicable.
- B. Install sediment control at existing inlets prior to any ground disturbances.
- C. Install sediment control at new inlets immediately following installation.

### 3.06 TEMPORARY CONSTRUCTION ENTRANCE

- A. Install in accordance with the details in the Drawings.
- B. Receive location approval from Owner / Owner's Representative prior to installation.
- C. Install at the location(s) where construction vehicles and equipment will leave the site to minimize siltation off the site.
- D. Temporary construction entrances shall not inhibit existing drainage conditions. Installation of temporary storm water conveyance structures shall be the responsibility of the Contractor.
- E. Remove and provide offsite disposal of all rock when the temporary construction entrance is no longer required.

### 3.07 CONCRETE WASHOUT FACILITY

- A. Install in accordance with the details in the Drawings.
- B. When the CWF is no longer required, remove all hardened concrete and waste materials.
- C. Removal shall include backfilling depressions and grading in accordance with the final grading plan.

### 3.08 SOIL STOCKPILES

- A. Provide temporary seeding where required by the General Permit.
- B. Install high flow silt fence around soil stockpiles as necessary to control sediment.
- C. Provide dust control in accordance with the General Permit.

#### 3.09 PORTABLE SANITARY FACILITIES

- A. Contractor shall supply at least one (1) portable sanitary facility onsite.
- B. Sanitary waste shall be collected from the portable units in a timely manner by a licensed waste management contractor or as required by local regulations.
- C. All contractors, subcontractors, inspectors and other personnel that are onsite for the purposes of the project shall use the portable facility and shall not use any public, private or exterior facilities that exist onsite or near the project area.

#### 3.10 CLEANING AND SWEEPING

- A. Sweeping is required during construction and before final completion of work to keep streets, sidewalks and other surfaces adjacent to and within the project area clean.
- B. The minimum equipment to be used for street sweeping shall be a skid loader with a pick up broom attachment or engineer approved equal.
- C. Sidewalks and other concrete surfaces shall be cleaned without producing tire marks or damaging the surface.
- D. Maintenance: Sweeping shall be performed as needed to remove tracked dirt & mud from the surfaces. Daily sweeping may be necessary if project conditions warrant. If fill is brought to the site or if excess earthen material is removed, the Contractor should expect to sweep the street at the end of each day.

#### 3.11 DUST CONTROL

- A. Use clean water to provide dust control.

#### 3.12 PERMANENT SEEDING & MULCHING

- A. Conform with Section 32 9200 – Turf and Grasses.

#### 3.13 DISPOSAL

- A. Disposal in a legal manner offsite. Burial of waste materials is not permitted.

### **END OF SECTION**

## SECTION 01 6000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 01 2500 "Substitution Procedures" for requests for substitutions.

#### 1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

#### 1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
  - a. Form of Architect's Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
  - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 3300 "Submittal Procedures." Show compliance with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
  1. Store products to allow for inspection and measurement of quantity or counting of units.
  2. Store materials in a manner that will not endanger Project structure.
  3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

6. Protect stored products from damage and liquids from freezing.

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
  1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
  - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
  - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
  - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
  - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  - 2. Evidence that proposed product provides specified warranty.
  - 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  - 4. Samples, if requested.

## PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

## SECTION 01 7300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
- B. Related Requirements:
  - 1. Section 01 1000 "Summary" for limits on use of Project site.
  - 2. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 5 copies showing the Work performed and record survey data.

#### 1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding.

- Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  2. Establish limits on use of Project site.

3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
  7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 1000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 7419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 9113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.
- D. If after meetings, reviews, comments, etc., there are documented changes not incorporated into the construction documents and installed equipment is not accessible for operation and maintenance, equipment shall be removed and reinstalled to facilitate maintenance access at no additional cost to the project.

END OF SECTION 01 7300

## SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Recycling nonhazardous demolition and construction waste.
  - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 04 2000 "Unit Masonry" for disposal requirements for masonry waste.
  - 2. Section 31 1000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

#### 1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

#### 1.3 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste recycled, both estimated and actual in tons.
  - 5. Total quantity of waste recovered (salvaged plus recycled) in tons.
  - 6. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

#### 1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements.
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination."

#### 1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Facilitate recycling and salvage of materials.

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
1. Distribute waste management plan to everyone concerned within three days of submittal return.
  2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
  2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
  - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.
  - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

### 3.3 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
  - 1. Pulverize concrete to maximum 4-inch size.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
  - 1. Pulverize masonry to maximum 1-1/2-inch size.
  - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
  - 1. Structural Steel: Stack members according to size, type of member, and length.
  - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

- F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
  - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- J. Carpet Tile: Remove debris, trash, and adhesive.
  - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- K. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- L. Conduit: Reduce conduit to straight lengths and store by material and size.
- M. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

### 3.4 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
  - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  - 2. Polystyrene Packaging: Separate and bag materials.
  - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
  - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
  - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
- D. Paint: Seal containers and store by type.

### 3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 01 7419

## SECTION 01 7700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.
- B. Related Requirements:
  - 1. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 2. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Section 01 7900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

#### 1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
  5. Submit testing, adjusting, and balancing records.
  6. Submit sustainable design submittals not previously submitted.
  7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 7900 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

## 1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
  - 1. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
  - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  - 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

## 1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 1. Organize list of spaces in sequential order, starting with exterior areas first proceeding from lowest floor to highest floor.
  - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  - 3. Submit list of incomplete items in the following format:
    - a. PDF electronic file. Architect, through Construction Manager, will return annotated file.

## 1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit by uploading to web-based project software site.
- D. Warranties in Paper Form:
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - c. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - d. Sweep concrete floors broom clean in unoccupied spaces.

- e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - f. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - g. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - h. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - i. Leave Project clean and ready for occupancy.
- C. In addition to requirements for site clean-up described in 6.13 of the General Conditions, include references to required final facility cleaning specified in separate Divisions.
- 1. Refer to Supplement Design Guide /Contractor Cleaning Standard
- D. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.
- E. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations, before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 01 7700

## SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
  - 2. Submit three paper copies. Architect, through Construction Manager, will return two Insert number copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
  - 2. Once all comments have been addressed, submit 3 hard copies and 1 digital copy of all closeout submittals to the owner for their records.
- D. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

- E. Refer to Section 09 Bidding and Construction for additional closeout documentation requirements.

### 1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold **8-1/2-by-11-inch (215-by-280-mm)** paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
  - 2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### 1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.

5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.
  9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## 1.5 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

## 1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
  1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
  1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

## 1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available.

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.
- H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

## 1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7823

## SECTION 01 7839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. Related Requirements:
  - 1. Section 01 7300 "Execution" for final property survey.
  - 2. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one of file prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit three paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and three set(s) of prints.
      - 3) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit three paper copies and one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit three paper copies annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

### 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made following Architect's written orders.
    - k. Details not on the original Contract Drawings.
    - l. Field records for variable and concealed conditions.
    - m. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file.
  3. Identification: As follows:

- a. Project name.
- b. Date.
- c. Designation "PROJECT RECORD DRAWINGS."
- d. Name of Architect and Construction Manager.
- e. Name of Contractor.

#### 1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as paper copy and scanned PDF electronic file(s) of marked-up paper copy of Specifications.

#### 1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as paper copy and scanned PDF electronic file(s) of marked-up paper copy of Product Data.
  - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

## 1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

END OF SECTION 01 7839

## SECTION 01 7900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

#### 1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.

#### 1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

## 1.5 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  - 4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.

- h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

## 1.6 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

## 1.7 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

END OF SECTION 01 7900

## SECTION 03 2000 - CONCRETE REINFORCING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Bar supports.
2. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Mechanical splice couplers.

B. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

## PART 2 - PRODUCTS

### 2.1 STEEL REINFORCEMENT

- A. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
- B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- C. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- D. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

### 2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
    - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
    - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; tension-compression type.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  - 1. Finish: Plain.
- D. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.

### 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
  - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
  - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement.
  - 2. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
  - 1. Steel-reinforcement placement.
  - 2. Steel-reinforcement mechanical splice couplers.
  - 3. Steel-reinforcement welding.

END OF SECTION 03 2000

## SECTION 03 3000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

##### B. Related Requirements:

1. Section 03 1000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 03 2000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 31 2000 "Earth Moving" for drainage fill under slabs-on-ground.

#### 1.2 DEFINITIONS

- ##### A. Cementitious Materials:
- Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

- ##### B. Water/Cement Ratio (w/cm):
- The ratio by weight of water to cementitious materials.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

For each of the following.

1. Fly ash.
2. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
3. Vapor retarders.
4. Liquid floor treatments.
5. Curing materials.
6. Joint fillers.

##### B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For liquid floor treatments and curing and sealing compounds, indicating compliance with requirements for low-emitting materials.

C. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - a. Location of construction joints is subject to approval of the Architect.

#### 1.4 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

#### 1.6 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

### 2.2 CONCRETE MATERIALS

- A. Cementitious Materials:

- 1. Portland Cement: ASTM C150/C150M, Type I, gray.
  - 2. Fly Ash: ASTM C618, Class C or F.

- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

- 1. Alkali-Silica Reaction: Comply with one of the following:

- a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
    - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
    - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

- 2. Maximum Coarse-Aggregate Size: 1 inch nominal.
  - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- C. Air-Entraining Admixture: ASTM C260/C260M.

- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

- 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Retarding Admixture: ASTM C494/C494M, Type B.
  - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable

## 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.4 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient Temperature Below 50 deg F: Black.
    - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
    - c. Ambient Temperature Above 85 deg F: White.
- C. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- D. Water: Potable or complying with ASTM C1602/C1602M.
- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- F. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Floor Slab Protective Covering: 8-feet-wide cellulose fabric.

## 2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash or Other Pozzolans: 25 percent by mass. (Omit Fly Ash in Cold-Weather Mixes)
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
  - 1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

## 2.8 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
  - 1. Exposure Class: ACI 318 F1.
  - 2. Minimum Compressive Strength: 4000 psi at 28 days.
  - 3. Maximum w/cm: 0.50.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content: 6.0 percent, plus or minus 1.0 percent
- B. Class B: Normal-weight concrete used for foundation walls.
  - 1. Exposure Class: ACI 318 F1.
  - 2. Minimum Compressive Strength: 4000 psi at 28 days.
  - 3. Maximum w/cm: 0.50.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content: 6.0 percent, plus or minus 1.0 percent
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
  - 1. Exposure Class: ACI 318 F0.
  - 2. Minimum Compressive Strength: 4000 psi at 28 days.
  - 3. Maximum w/cm: 0.45.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content:

- a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- D. Class D: Normal-weight concrete used for interior suspended slabs.
  - 1. Exposure Class: ACI 318 F0.
  - 2. Minimum Compressive Strength: 4000 psi at 28 days.
  - 3. Maximum w/cm: 0.45.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content:
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- E. Class E: Normal-weight concrete used for exterior concrete slabs.
  - 1. Exposure Class: ACI 318 F3.
  - 2. Minimum Compressive Strength: 4500 psi at 28 days.
  - 3. Maximum w/cm: 0.45.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content: 6.0 percent, plus or minus 1.0 percent
- F. Class F: Normal-weight concrete used for interior metal pan stairs and landings:
  - 1. Exposure Class: ACI 318 F0.
  - 2. Minimum Compressive Strength: 3000 psi at 28 days.
  - 3. Maximum w/cm: 0.45.
  - 4. Minimum Cementitious Materials Content: 470 lb/cu. yd..
  - 5. Maximum Size Aggregate: 1/2 inch.
  - 6. Slump Limit: 3 inches, plus 1 inch or minus 2 inches.
  - 7. Air Content: 0 percent, plus or minus 0.5 percent at point of delivery.
  - 8. Retarding Admixture: Not allowed.
  - 9. Accelerating Admixture: Not allowed.

## 2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
  - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.2 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  - 2. Face laps away from exposed direction of concrete pour.
  - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  - 7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

### 3.3 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  - 2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

### 3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  - 1. If a section cannot be placed continuously, provide construction joints as indicated.
  - 2. Deposit concrete to avoid segregation.
  - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Do not place concrete floors and slabs in a checkerboard sequence.
  - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 3. Maintain reinforcement in position on chairs during concrete placement.
  - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 5. Level concrete, cut high areas, and fill low areas.
  - 6. Slope surfaces uniformly to drains where required.
  - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  - 8. Do not further disturb slab surfaces before starting finishing operations.

### 3.5 FINISHING FORMED SURFACES

#### A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class D.
  - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
3. ACI 301 Surface Finish SF-3.0:
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/8 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class A.
  - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

#### B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.6 FINISHING FLOORS AND SLABS

#### A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

#### B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.

3. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

### 3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  3. Minimum Compressive Strength: 4000 psi at 28 days.
  4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
  2. Screed, tamp, and trowel finish concrete surfaces.

### 3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
  2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
  3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  3. If forms remain during curing period, moist cure after loosening forms.

4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
  - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
  - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
  - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
  - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
  - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
    - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
  - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
    - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
      - a) Lap edges and ends of absorptive cover not less than 12 inches.
      - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
    - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
      - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
      - b) Cure for not less than seven days.
    - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
      - a) Water.
      - b) Continuous water-fog spray.

- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
  - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
  - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.

- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
  - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
  - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
  - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Maintain continuity of coating, and repair damage during curing period.
  - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- g. Floors to Receive Curing and Sealing Compound:
- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.9 TOLERANCES

- A. Conform to ACI 117.

### 3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 14 days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.

4. Rinse with water; remove excess material until surface is dry.
  5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

### 3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.
      - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
      - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
  - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow: ASTM C1611/C1611M:
  - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M:
  - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C31/C31M:
  - a. Cast and laboratory cure two sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
  - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:
  - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
  - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### 3.12 PROTECTION

#### A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 3000

## **SECTION 03 41 00**

### **PRECAST STRUCTURAL CONCRETE**

#### **PART 1 GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Precast structural concrete.
- B. Refer to Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS for LEED requirements affecting work of this section.

##### **1.2 DEFINITION**

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

##### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated on Drawings.
  - 1. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.
    - a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus 20 to plus 80 deg F.
  - 2. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

##### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
  - 1. Indicate joints, reveals, and extent and location of each surface finish.
  - 2. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.

3. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
4. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
5. Include and locate openings larger than 10 inches.
6. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
7. Indicate relationship of precast structural concrete units to adjacent materials.
8. Indicate shim sizes and grouting sequence.
9. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
10. Sign and seal shop drawings by South Dakota registered professional engineer.

D. Samples:

1. For each type of finish indicated on exposed surfaces of precast structural concrete units with architectural finish, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
  - a. Where other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

E. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation registered in South Dakota.

1. Submit loading diagrams and performance criteria used in the design, including tolerance assumed, for review and acceptance.
2. Submit one set of stamped and signed design calculations for record only, calculations will not be returned.
3. Include calculated fire-resistance analysis.

F. Qualification Data: For Installer and fabricator.

G. Welding certificates.

H. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.

I. Material Test Reports: For aggregates.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Participates in PCI's Plant Certification program at time of bidding and is designated a PCI-certified plant.
- B. Installer Qualifications: A precast concrete erector qualified at time of bidding, as evidenced by PCI's Certificate of Compliance, to erect Category S2 - Complex Structural Systems.
- C. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel."
  2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets the prescriptive requirements of authorities having jurisdiction or has been calculated according to ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies," or PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.
- G. Sample Panels: After sample approval and before fabricating precast structural concrete units with architectural finish, produce a minimum of 2 sample panels approximately 16 sq. ft. in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
  1. Locate panels where indicated or, if not indicated, as directed by Architect.
  2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
  3. After approval of repair technique, maintain one sample panel at fabricator's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
  4. Demolish and remove sample panels when directed.
- H. Mockups: After sample panel approval but before production of precast structural concrete units with architectural finish, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockup as indicated on Drawings including sealants and precast structural concrete units, including vomitory wall or a bowl tread section with an architectural finish complete with anchors, connections, flashings, and joint fillers.
  2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at Project site.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
  - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
  - 2. Place adequate dunnage of even thickness between each unit.
  - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.
- D. Lift and support units only at designated points shown on Shop Drawings.

## 1.7 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

# PART 2 PRODUCTS

## 2.1 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
  - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

## 2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed, where indicated on Drawings.
- C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 or ASTM A 706/A 706M, deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized, and chromate wash treated after fabrication and bending.

- D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 or ASTM A 706/A 706M, deformed bars, ASTM A 775/A 775M epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- E. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel galvanized-steel wire into flat sheets.
- F. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- G. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

### 2.3 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416/A 416M, Grade 270, uncoated, 7-wire, low-relaxation strand.

### 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure and as required to provide uniformity at seating bowl,, mix gray with white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
  - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 4S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
  - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M.

## 2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable-Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30.
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- K. Zinc-Coated Finish: For items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.
  - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- L. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 or SSPC-Paint 25 according to SSPC-PA 1.
- M. Welding Electrodes: Comply with AWS standards.
- N. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

## 2.6 STAINLESS-STEEL CONNECTION MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 116.

## 2.7 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
  - 1. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test 1 specimen for every 200 pads used in Project.

## 2.8 GROUT MATERIALS

- A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

## 2.9 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
  - 1. Use fly ash, pozzolan, and ground granulated blast-furnace slag as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Minimum Compressive Strength (28 Days): 5000 psi.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.
- I. See structural drawings for additional requirements.

## 2.10 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and de-tensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
  - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - 1. Form joints are not permitted on faces exposed to view in the finished work.
  - 2. Edge and Corner Treatment: Uniformly chamfered.

## 2.11 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
  - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
  - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
  - 3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to deicing salts, corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
  - 1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
  - 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
  - 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
  - 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
- L. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- M. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- N. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.
- O. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- P. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

## 2.12 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.

## 2.13 COMMERCIAL FINISHES

- A. Grade A Finish: Fill surface blemishes with the exception of air holes 1/16 inch in width or smaller, and form marks where the surface deviation is less than 1/16 inch. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.
  - 1. Application: For formed surfaces indicated to be painted.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
  - 1. Application: For unformed surfaces concealed from view in completed construction.
- C. Apply roughened surface finish according to ACI 318 to precast concrete units that will receive concrete topping after installation.

## 2.14 COMMERCIAL ARCHITECTURAL FINISHES

- A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform, straight, and sharp. Finish exposed-face surfaces of precast concrete units to match approved sample panels and as follows:
  - 1. Smooth-Surface Finish: Provide surfaces free of excessive air voids, sand streaks, and honeycombs, with uniform color and texture.

## 2.15 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements.
- B. Strength of precast structural concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- C. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
  - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  - 2. Cores will be tested in an air-dry condition or, if units will be wet under service conditions, test cores after immersion in water in a wet condition.
  - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.

4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
  - a. Project identification name and number.
  - b. Date when tests were performed.
  - c. Name of precast concrete fabricator.
  - d. Name of concrete testing agency.
  - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- E. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

### **3.2 INSTALLATION**

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
  1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
  2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
  1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of the Architect.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
  1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
  2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
  3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
  4. Remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
  1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- H. Grouting: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.
  1. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
  2. Fill joints completely without seepage to other surfaces.
  3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
  4. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
  5. Keep grouted joints damp for not less than 24 hours after initial set.

### 3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be visually inspected and nondestructive tested according to ASTM E 165 or ASTM E 709.
- C. Field welds in connections of all precast units and all connections for the work of other trades welded to embed plates in precast units will be visually inspected.
- D. Minimum of 10% of the field welded connections of precast units will be inspected by magnetic particle.
- E. Testing agency will report test results promptly and in writing to Contractor and Architect.
- F. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

### 3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Architect.
  - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units has not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

### 3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

**END OF SECTION**

## SECTION 05 1200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors, shop welded.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 05 3100 "Steel Decking" for field installation of shear stud connectors through deck.

#### 1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

#### 1.3 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

B. Shop Drawings: Show fabrication of structural-steel components.

- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 360.
  - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  - 1. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
    - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
    - b. Use Load and Resistance Factor Design; data are given at factored-load level.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A992/A992M.
- C. Channels, Angles, M-Shapes: ASTM A36/A36M.
- D. Plate and Bar: ASTM A36/A36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

### 2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1, compressible-washer type with plain finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Plain.
- D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

## 2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.
  - 1. Configuration: Straight.
  - 2. Finish: Plain.
  - 3. Exterior applications shall be Hot Dip Galvanized
- B. Threaded Rods: ASTM A36/A36M.
  - 1. Finish: Plain.

## 2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

## 2.6 PRIMER

- A. Steel Primer:
  - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
- B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

## 2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

## 2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces unless indicated to be painted.
  - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  - 1. SSPC-SP 2.

2. SSPC-SP 3.
  3. SSPC-SP 7 (WAB)/NACE WAB-4.
  4. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## 2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.
    - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E164.
    - d. Radiographic Inspection: ASTM E94/E94M.
  4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M.
  5. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

### 3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- 1) Liquid Penetrant Inspection: ASTM E165/E165M.
- 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
- 3) Ultrasonic Inspection: ASTM E164.
- 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 1200

## SECTION 05 2100 - STEEL JOIST FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. LH-series long-span steel joists.
  - 2. Steel joist accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Sustainable Design Submittals:
  - 1. **Product Data:** For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- C. Shop Drawings:
  - 1. Include layout, designation, number, type, location, and spacing of joists.
  - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
  - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 STEEL JOISTS

- A. Long-Span Steel Joist: Manufactured steel joists in accordance with "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.

### 2.2 PRIMERS

- A. Primer:
  - 1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

### 2.3 STEEL JOIST ACCESSORIES

- A. Bridging:
  - 1. Schematically indicated. Detail and fabricate in accordance with SJI's "Specifications." Furnish additional erection bridging if required for stability.
- B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.
  - 1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Plain.
- D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

### 2.4 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.
- B. Apply one coat of shop primer to joists and joist accessories.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction in accordance with SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds in accordance with AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 05 2100

## SECTION 05 3100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:

1. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

A. Qualifications:

1. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding code:
  - a. AWS D1.3/D1.3M.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

### 2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
  - 1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard.
  - 2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
    - a. Provide galvanized roof deck at areas requiring spray applied fireproofing
  - 3. Deck Profile: As indicated.
  - 4. Profile Depth: As indicated.
  - 5. Design Uncoated-Steel Thickness: As indicated.
  - 6. Span Condition: As indicated.
  - 7. Side Laps: Overlapped.

### 2.3 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.

## 2.4 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- J. Galvanizing Repair Paint: ASTM A780/A780M.
- K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

### 3.2 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
  - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps as indicated on plans and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
  - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

### 3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 5/8 inch, nominal.
  2. Weld Spacing:
    - a. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side as indicated on plans and as follows:
1. Fasten with a minimum of 1-1/2-inch-long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
    - a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 05 3100

## SECTION 05 4000 - COLD-FORMED METAL FRAMING

### 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.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Exterior non-load-bearing wall framing.

- B. Related Requirements:

- 1. Section 09 2216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings:

- 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated-Design Submittal: For cold-formed steel framing.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  1. Design Loads: As indicated on Drawings.
  2. Deflection Limits: As indicated on Drawings.
  3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 1 inch.
  4. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
  1. Floor and Roof Systems: AISI S210.
  2. Wall Studs: AISI S211.
  3. Headers: AISI S212.
  4. Lateral Design: AISI S213.
- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

### 2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  1. Grade: As required by structural performance.
  2. Coating: G60, A60, AZ50, or GF30.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
  1. Grade: As required by structural performance.

2. Coating: G60.

## 2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
  1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

## 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. Anchor clips.
  5. End clips.
  6. Foundation clips.
  7. Stud kickers and knee braces.
  8. Hole-reinforcing plates.
  9. Backer plates.

## 2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure.
  - 2. Type: Torque-controlled expansion anchor, Torque-controlled adhesive anchor or adhesive anchor.
  - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

## 2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780/A 780M.
- B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## 2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-

resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
  - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

## SECTION 05 5000 - METAL FABRICATIONS

### 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.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Miscellaneous steel framing and supports.
- 2. Loose bearing and leveling plates.

- B. Products furnished, but not installed, under this Section include the following:

- 1. Loose steel lintels.
- 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Fasteners.
- 2. Shop primers.
- 3. Shrinkage-resisting grout.
- 4. Manufactured metal ladders and ships ladders.

- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

- C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design ladders.

- B. Structural Performance of Aluminum Ladders: Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
  - 2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.
  - 3. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
- F. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- G. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- H. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening stainless steel.

## 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

- D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches from ends and corners of units and 24 inches o.c.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

- B. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
  - 1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

## 2.7 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

## 2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize and prime loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

## 2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.

## 2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  3. Items Indicated to Receive Primers Specified in Section 09 9600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for

use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

### 3.3 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.4 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5000

## **SECTION 31 2300**

### **EXCAVATION AND FILL**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. This Section includes excavation and fill for trenches, sidewalks, concrete and asphalt surfaces, and other areas.

##### **1.02 REFERENCES**

- A. South Dakota Department of Transportation (SD DOT) Standard Specifications for Roads & Bridges, 2015 Edition, including all subsequent revisions.
  - 1. Section 120 – Roadway and Drainage Excavation and Embankment Construction
  - 2. Section 260 – Granular Bases and Surfacing
- B. South Dakota State University (SDSU) Design Standards.
- C. Geotechnical Exploration Program Report – completed by Geotek Engineering & Testing Services, Inc dated September 20, 2019.
  - 1. Owner is not responsible for interpretations or conclusions drawn from this data. Report is available for informational purposes only.
  - 2. Bidders are encouraged to confer with the geotechnical engineer who prepared the report and to obtain additional information regarding the site that may be valuable in preparing the bid.

#### **PART 2 PRODUCTS**

##### **2.01 GENERAL**

- A. General: All products shall be consistent with the SD DOT Standard Specifications, unless indicated herein.

##### **2.02 TOPSOIL**

- A. Free from rocks larger than 2".
- B. Organic Matter: 3% - 15% (ASTM D2974)
- C. pH: 6.1 – 7.8 (ASTM G51)
- D. Provide and verify soil will provide viable planting soil.
- E. Soil shall be clean of sod, roots, clumps, concrete materials, building debris, and other extraneous materials harmful to plant growth.

##### **2.03 OTHERS**

- A. See materials types and specifications in the geotechnical report.

#### **PART 3 EXECUTION**

### 3.01 GENERAL

- A. Conform to SDSU Design and Construction Standards – Division 31 and SD DOT Standard Specifications, except as modified herein.
- B. Identify required lines, levels, contours and datum locations.
- C. Locate, identify, and protect existing utilities that remain and protect from damage.
- D. Notify utility company to remove and relocate utilities.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Protect trees, plants, lawns, rock outcroppings, and other features to remain. This shall include the installation of orange safety fence around such items.

### 3.02 PREPARATION

- A. 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.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### 3.03 TRAFFIC CONTROL

- A. Traffic control shall be the responsibility of the Contractor.
- B. Provide in conformance to with the most current addition of the Manual of Uniform Traffic Control Devices (MUTCD).
- C. No separate payment will be provided for traffic control, unless indicated in the Drawings and included in the bid form.
- D. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Contractor is responsible for providing advance notice of street closures in accordance with SDSU requirements.
- E. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

### 3.04 TOPSOIL STRIPPING

- A. Strip existing topsoil as required for new structures and surfaces.
- B. Topsoil from the upper 6" of the in-place soil horizon may be stockpiled for reuse.
- C. As part of the salvage operation, all debris and any stones exceeding three inches (3") in any dimension shall be removed prior to stockpiling.
- D. Salvaged topsoil shall be stockpiled in a location chosen by the Contractor and approved by the Owner/Owner's Representative and protected in accordance with best management practices for erosion control. This may include placing High Flow Silt Fence around the perimeter of the stockpile and/or temporary seeding with an annual species such as oats or wheat.

- E. Due to limited space, any salvaged topsoil from this project may require stockpiling offsite.
- F. Provide temporary drainage structures as needed to protect the site.

### 3.05 EXCAVATION AND EMBANKMENT CONSTRUCTION

- A. Excavation and embankment construction shall be performed in accordance with Section 120 of the SDDOT Standard Specifications, except as modified herein.
- B. Compaction requirements shall be governed by the Specified Density Method.
- C. Excess moisture in the embankment material shall be removed by drying operations.
- D. All excess excavation, including topsoil, shall be retained by SDSU and shall be hauled by the Contractor to any SDSU property within three (3) miles of the project.
- E. Excess excavation shall be screened if necessary to eliminate any rock or other debris not suitable for fill or topsoil.
- F. Contaminated or unusable material shall be removed and legally disposed.
- G. Provide granular structural fill where needed to reach subgrade elevations.

### 3.06 BUILDING SITE PREPARATION

- A. General: All building site preparation shall be completed in accordance with the geotechnical report, unless more stringent requirements are included herein or in the plans. Nothing in this specification may reduce the overall quality required by the recommendations of the geotechnical engineer.
- B. All vegetation, topsoil, pavements and sidewalks shall be removed from the entire building footprint prior to preparation for the foundations.
- C. Relocate utilities within the building footprint as necessary prior to foundation preparation. In no case shall piping or utility structures be abandoned in-place within the building footprint.
- D. Following removals and relocation of underground utilities, complete site preparation, foundation preparation and foundation wall backfilling in accordance with the geotechnical report, unless more stringent requirements are included herein or in the plans.
- E. Soils borings are included in the geotechnical report for reference.
- F. For the footing excavation, the excavation must extend a minimum of 2-feet or 3-feet below the bottom-of-footing elevation based on the wall and column loads as specified in the geotechnical report. Granular structural fill shall be placed and compacted in the area over excavated below the footing. The over excavations may extend to greater depths if the existing fill materials and fine alluvium soils are not completely removed.
- G. The Contractor shall be responsible for coordinating with the geotechnical engineer to observe excavation depths, obtain recommendations, provide notifications for testing, and attain approvals as the work proceeds.
- H. Excavating and backfilling shall be completed in conformance with the geotechnical report, and as may be revised during construction based on the observations and recommendations of the geotechnical engineer.

- I. Floor Slab: Site preparations shall be completed as recommended in the geotechnical report. See structural plans for option selected.
- J. In accordance with the geotechnical report, the free-draining sand used on exterior wall backfill (in areas that will not have asphalt or concrete surfacing) shall be capped with at least 1 foot to 2-feet of clay soils to minimize infiltration of surface water.

### 3.07 CONTAMINATED SOILS

- A. General: If any environmental contaminants are uncovered during the work, the Owner's Representative and geotechnical engineer shall be contacted immediately for review, documentation, and guidance.
- B. Contaminated soils shall be disposed in a lawful manner, in accordance with all local, state, and federal requirements and regulations.

### 3.08 UTILITY TRENCHING

- A. General: Conform to the specifications and requirements of each utility being installed, except as modified herein.
- B. Comply with the most current edition of OSHA Excavation Safety Standards.
- C. In accordance with the law, the Contractor shall request utility locates from South Dakota One Call prior to ground disturbances.
- D. Underpin adjacent structures that could be damaged by excavating work.
- E. Excavate to accommodate underground utilities.
- F. Notify Owner's Representative of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- G. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Cut utility trenches wide enough to allow inspection of installed utilities.
- J. Install utilities in accordance with the referenced specifications, plan details, or local standards.
- K. Verify slope and depth of utilities in accordance with the plans and construction grade stakes.
- L. Maintain minimum depths as required for frost protection.
- M. Notify Owner's Representative of any unforeseen utility conflicts.
- N. Hand trim excavations and remove loose matter.
- O. Remove any rock larger than 4", and do not use to backfill utility trenches.
- P. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- Q. Monitor weather forecasts and take appropriate measures to minimize flooding potential, protect construction progress, and minimize the transport of sediment leaving the site.
- R. Place specified bedding material completely under pipe haunches in uniform layers.
- S. Hand (shovel) tamp along pipe within haunch zone to provide a solid pipe foundation, completely free of voids.

- T. Place backfill in uniform loose lifts not to exceed 6-inches prior to compaction. Avoid compaction directly over the pipe that may damage the system. Complete compaction and required testing prior to placing next layer.
- U. Topsoil may not be used to backfill any trench. Utilize acceptable onsite material only.
- V. Compaction of backfill shall be minimum 95% Standard Proctor density and from 1% above to 4% below optimum moisture content.
- W. In the upper 3-feet of the subgrade, compaction shall be minimum 97% Standard Proctor density and from 1% to 4% below optimum moisture content.
- X. Drying operations shall be performed as needed to meet the required moisture conditions.
- Y. Remove excavated material that is unsuitable for re-use from site.
- Z. Remove excess excavated material to an Owner requested location.

### 3.09 DEWATERING

- A. Dewatering is the Contractor's responsibility.
- B. Review geotechnical exploration report if available.
- C. Dispose of groundwater is a safe matter approved by the South Dakota Department of Environment and Natural Resources (SDDENR).
- D. Water may not, in any case, be directed into any sanitary sewer system.
- E. No separate payment will be provided for dewatering.

### 3.10 SUBGRADE PREPARATION

- A. Prior to placement of geotextile fabric or granular surfacing materials, the upper twelve (12) inches (minimum) of subgrade shall be reworked and recompacted to moisture and density requirements stated in the Geotechnical Report. Scarification of the subgrade materials will be required in all surfaced areas, including sidewalk.
- B. The subgrade shall be compacted to a minimum of 97% Standard Proctor density, and from 1% to 4% below optimum moisture content.
- C. Scarification, moisture conditioning and compaction of the subgrade will be required in all areas to surfaced, including sidewalks and gravel drives.
- D. After completing subgrade shaping and compaction, and prior to placement of base course, the Contractor shall contact the Owner's Representative to complete a proof roll of the prepared subgrade.
- E. The Contractor shall provide a tandem truck loaded with at least 10 tons of material. Following the proof roll, the Contractor will be required to rework any unstable subgrade as determined by the Owner's Representative and then proof roll again to prove that the subgrade is ready for base course.
- F. This process will be repeated as many times as the Owner's Representative requires. Base materials (or geotextile fabric, if required) shall not be placed until the Owner's Representative is satisfied that the subgrade is stable.
- G. Unstable areas may be corrected using the methods listed in the geotechnical report.

### 3.11 PLACING TOPSOIL

- A. Topsoil shall be spread evenly and uniformly in the planting bed areas to a depth of 24" (minimum) and over all other seeded areas to a depth of 12" (minimum).
- B. Topsoil shall be provided by the Contractor as needed to meet the minimum depth requirements.
- C. The Owner will not provide any topsoil.
- D. Excess, waste or contaminated topsoil shall be hauled and stockpiled on an SDSU property within three (3) miles of the project. Topsoil shall not be used as fill in any areas. Only clean clay or suitable engineered fill shall be used in any fill areas.
- E. All topsoil shall be finish graded to seed-bed standards.
- F. Prior to seeding, the Contractor shall be responsible for coordinating and receiving approval from the Owner/Owner's Representative of the finished grade. Prepare ground for seeding in conformance with Section 32 9200 – Turf and Grasses.

### 3.12 DISPOSAL

- A. Disposal of waste earthen material shall be as specified herein. The Contractor shall include in his bid all costs for excavating, loading, hauling and stockpiling usable excess earthen material, including topsoil, to an SDSU property within three (3) miles of the project.
- B. All requests for proposals or construction changes, which may affect excess material quantities, shall also include excavating, loading, hauling and stockpiling as indicated herein.

### END OF SECTION

## SECTION 31 6216 - STEEL HELICAL PILES

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.02 SUMMARY

- A. Section includes the furnishing of all designs, materials, tools, equipment, labor and supervision, and installation techniques necessary to install Helical Piles as detailed on the drawings, including connection details.

#### 1.03 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

#### 1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Submit drawings showing fabrication and installation details for piles, including details of helix plates, splices, and pile caps.
  - 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
  - 2. Indicate methods of corrosion protection.
  - 3. Submit structural analysis data signed and sealed by a qualified professional engineer responsible for their preparation and registered in the State of this project.
- C. Calibration Reports: Submit copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty five (45) working days of the date submitted. Helical Pile installation and testing shall not proceed until the Owner has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:
  - 1. Name of project and Contractor
  - 2. Name of testing agency
  - 3. Identification (serial number) of device calibrated
  - 4. Description of calibrated testing equipment
  - 5. Date of calibration
  - 6. Calibration data
- D. Installation Records: Submit copies of Helical Pile installation records within 24 hours after each installation is completed. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information:
  - 1. Name of project and Contractor
  - 2. Name of Contractor's supervisor during installation
  - 3. Date and time of installation
  - 4. Name and model of installation equipment
  - 5. Type of torque indicator used

6. Location of Helical Pile by assigned identification number
7. Actual Helical Pile type and configuration - including lead section (number and size of helix plates), number and type of extension sections
8. Helical Pile installation duration and observations
9. Total length of installed Helical Pile
10. Cut-off elevation
11. Inclination of Helical Pile
12. Installation torque at one-foot intervals for the final 10 feet
13. Comments pertaining to interruptions, obstructions, or other relevant information
14. Rated load capacities

#### 1.05 INFORMATION SUBMITTALS

- A. Welding certificates.
- B. Mill Test Reports: For steel pipes and steel plate, signed by manufacturer.
- C. Pile-Installation Equipment Data: Include type, make, and torque rating.
- D. Pile-Driving Records: Submit within three days of driving each pile.
- E. Certified Piles Survey: Submit within seven days of pile driving completion.
- F. Field quality-control reports.
- G. Preconstruction Photographs: Photographs or video of existing conditions of adjacent construction. Submit before the Work begins.

#### 1.06 QUALITY ASSURANCE

- A. Helical Pile Contractor Qualifications: The contractor shall be experienced in performing design and construction of helical piles, and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall be trained and certified by the manufacturer of the helical piles in the proper methods of design and installation of helical piles. The Contractor shall provide names of on-site personnel involved with the work. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for the testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.07 DESIGN CRITERIA

- A. Helical Piles shall be designed to meet the specified loads and acceptance criteria as shown on the drawings. The calculations and drawings required from the Contractor shall be submitted to the Owner for review and acceptance.
- B. The overall length and installed torque of a Helical Pile shall be specified such that the required in-soil capacity is developed by end-bearing on the helix plate(s) in an appropriate strata(s).

## 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent buckling or physical damage.
  - 1. Painted Piles: Protect finish and touch up paint damage before driving piles.

## 1.09 FIELD CONDITIONS

- A. Protect structures, underground utilities, and other construction from damage caused by pile driving.
- B. Site Information: A geotechnical report has been prepared for this Project and is included elsewhere in the Project Manual for information only.
- C. Preconstruction Photographs: Inventory and record the condition of adjacent structures, underground utilities, and other construction. Document conditions that might be misconstrued as damage caused by pile driving. Comply with Section 013233 "Photographic Documentation."

## PART 2 PRODUCTS

### 2.01 STEEL SHAFT

- A. The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be RS (Round Shaft).
  - 1. The size and material strength of the shaft shall be as required to support the loads as indicated on the structural drawings.

### 2.02 HELIX PLATES

- A. Plates shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall be as required to support the loads as indicated on the structural drawings.

### 2.03 BOLTS

- A. The size, quantity, and type of bolts used to connect the central steel shaft sections together shall be as required to support the loads as indicated on the structural drawings.

### 2.04 CORROSION PROTECTION

- A. Galvanization: All material shall be hot-dipped galvanized in accordance with ASTM A153 after fabrication.

### 2.05 FABRICATION

- A. Fabricate and assemble piles in shop to greatest extent possible.
- B. Pile-Length Markings: Mark each pile with horizontal lines at 12-inch intervals; label the distance from pile tip at 60-inch intervals. Maintain markings on piles until driven.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Site Conditions: Do not start pile operations until earthwork fills have been completed or excavations have reached an elevation of 6 to 12 inches above bottom of footing or pile cap.

### 3.02 INSTALLATION EQUIPMENT

- A. Helical Piles shall be installed with high torque, low RPM torque motors, which allow the helical screw plates to advance with minimal soil disturbance.
- B. Equipment shall be rotary type, hydraulic power driven torque motor with clockwise and counter- clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.
- C. Equipment shall be capable of applying adequate down pressure and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper Helical Pile alignment.
- D. A torque indicator shall be used during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. The torque indicator shall:
  - 1. Be capable of providing continuous measurement of applied torque throughout the installation.
  - 2. Be capable of torque measurements in increments of at least 500 ft-lb
  - 3. Be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment, shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling, shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.
  - 4. Be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

### 3.03 PILE INSTALLATION

- A. The Helical Pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.
- B. The lead section shall be positioned at the location as shown on the working drawings. Battered Helical Piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established.
- C. The Helical Pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.

- D. Sufficient down pressure shall be applied to uniformly advance the Helical Pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.
- E. Termination Criteria
1. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.
  2. The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.
  3. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
    - a. Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:
    - b. Remove the existing Helical Pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.
  4. Do not re-use Type RS Helical Pile shaft material after the coupling bolt holes have been noticeably elongated during a previous installation.
  5. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:
    - a. Install the Helical Pile deeper using additional extension sections, or:
    - b. Remove the existing Helical Pile and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.
    - c. De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rate capacity and additional Helical Pile location shall be subject to the review and acceptance of the Owner.
  6. If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Owner.
  7. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.
  8. The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

### 3.04 ALLOWABLE TOLERANCES

- A. Centerline of Helical Piles shall not be more than 3 inches from indicated plan location.

- B. Helical Pile plumbness shall be within 2° of design alignment.
- C. Top elevation of Helical Pile shall be within+ 1 inch to -2 inches of the design vertical elevation.

### 3.05 FIELD QUALITY CONTROL

- A. Special Inspections and testing: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Helical pile installation.
  - 2. Welding
- B. Tests and Inspections:
  - 1. Weld Testing: In addition to visual inspection, welds shall be tested and inspected according to AWS D1.1/D1.1M and inspection procedures listed below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Radiographic Inspection: ASTM E 94, minimum quality level "2-2T."
    - d. Ultrasonic Inspection: ASTM E 164.
- C. Prepare test and inspection reports.

### 3.06 DISPOSAL

- A. Remove withdrawn piles and cutoff sections of piles from site, and legally dispose of them off Owner's property.

END OF SECTION

## **SECTION 33 1000**

### **WATER UTILITIES**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. This Section includes water distribution piping and components outside of any building footprint.

##### **1.02 REFERENCES**

- A. Brookings Municipal Utilities (BMU) Specifications – Standard Specifications for Water Main Construction (current edition)
- B. BMU Standard Plates for Water Main Construction
- C. BMU Water Distribution Design Standards
- D. South Dakota State University (SDSU) Design Standards

##### **1.03 SUBMITTALS**

- A. Submit product data and technical information on the following items:
  - 1. Pipe, pipe bedding, hydrants, valves, fittings, joint restraints, and tracer wire systems.
  - 2. Other items related to the water distribution system indicated in the Drawings.

#### **PART 2 PRODUCTS**

##### **2.01 GENERAL**

- A. General: All products shall be consistent with the specifications and acceptable to the utility company. Conform to the most current edition of the BMU Standard Specifications for Water Main Construction.
- B. All materials shall be furnished by the Contractor. All references to city furnished materials in BMU Specifications shall be deleted.

##### **2.02 POLY VINYL CHLORIDE (PVC) PIPE (4"-12")**

- A. Conform to the most current edition of AWWA C900 Standards, DR-18 (235 psi)
- B. Rated for 150 psi working pressure.
- C. Gaskets shall be in conformance with ASTM F-477 and must utilize the Rieber joining system.
- D. All pipe and gaskets shall meet NSF/ANSI Standard 61 – Drinking Water System Components, Health Effects.

##### **2.03 PIPE BEDDING**

- A. General: Conform to BMU Standard Specifications for material type and gradation.
- B. Pipe bedding shall consist of ¼" x ¾" clean angular crushed rock.

- C. Pipe bedding will be required on all water main and service piping.
- D. Unless included in the bid form, pipe bedding material shall be incidental to the unit bid price for the piping, and no separate payment will be made.

#### 2.04 HYDRANTS

- A. General: Dry barrel conforming to the most current addition of ANSI/AWWA C502.
- B. 6-inch mechanical joint pipe connection.
- C. Minimum 150-psi working pressure and 300-psi test pressure.
- D. Operating Nut: 1-1/2 inch pentagon, National Standard Threads
- E. Main valve not less than 5-1/4 –inches.
- F. Type 304 stainless steel hardware.
- G. Nozzles shall conform to the requirements of the utility company and fire department having jurisdiction. Nozzle caps shall include metal chains.
- H. Centerline of the lowest nozzle shall be 18” to 24” above finished ground elevation.
- I. Traffic section with breakaway flange and coupling rod required.
- J. Bury Depth: 7-feet.
- K. Hydrants shall be capable of being extended in 6-inch increments and shall be equipped with traffic features that include breakaway flange and stem with a shaft coupling.
- L. Fiberglass Flag: Hinged, 48-inch length, 3-inch width, reflective. FH 800 Series American model manufactured by Flexstake or approved equal.
- M. Hydrant above ground shall be painted with epoxy primer and high-gloss urethane coating.
- N. Hydrant Color: **Yellow**.
- O. Poly wrap all ductile iron parts below grade.
- P. Approved Manufacturer: Waterous Pacer WB-67-250, Contemporary Style or prebid approved equal.

#### 2.05 GATE VALVES & BOXES (4”-12”)

- A. Conform to the most current addition of ANSI/AWWA C515 and able to withstand a working pressure of 250 psi.
- B. Open left (counter-clockwise) resilient-seated gate valves.
- C. Standard 2” ductile iron operating nut.
- D. All internal and external surfaces shall have fusion bonded epoxy coating in conformance with ANSI/AWWA C550.
- E. Non-rising stem.
- F. 304 stainless steel bonnet and stuffing box hardware.
- G. Approved manufacturers: American AVK, American Flow Control (AFC), Mueller, Waterous, or approved equal.
- H. Wrap all gate valves, joint restraints and valve boxes in polyethylene film.
- I. Valve Box:
  - 1. 2 or 3 piece, cast iron, screw type
  - 2. 5-1/4 inch diameter shaft.
  - 3. Heavyweight 35,000-pound tensile strength.

4. Cast iron drop cover marked "WATER".
  5. Include approved valve box adapter.
- J. Valve Box Adaptor:
1. Provide manufacturer recommended valve box adaptor.
  2. Must center the valve box over the operating nut.
  3. Allows for keying of the valve nut and eliminates settling or shifting of the valve box.

## 2.06 DUCTILE IRON, MECHANICAL JOINT FITTINGS

- A. General: Conform to BMU Standard Specifications and the most current edition of AWWA C153 for compact ductile iron fittings.
- B. Mechanical joints required on all ductile iron fittings.
- C. Fittings shall be lined and coated per BMU Standard Specifications.
- D. Nuts and bolts shall be fluorocarbon coated (Birmingham Fastener Cor-Blue) on all mechanical joints.
- E. Ductile iron shall be wrapped in polyethylene film.
- F. Approved Manufacturers: Sigma, Star, Tyler or approved equal.

## 2.07 JOINT RESTRAINTS

- A. High-strength ductile iron conforming to the most current edition of ASTM A536.
- B. Fusion bonded epoxy coated.
- C. Nuts and bolts shall be fluorocarbon coated (Birmingham Fastener Cor-Blue) on all mechanical joints.
- D. Approved Manufacturers: EBBAA Iron, Inc - Megalug, Romac Industries, Inc. – RomaGrip, Star Pipe Products – Stargrip; Tyler Union – TUF Grip Series 2000; or approved equal.

## 2.08 TRACER WIRE SYSTEM

- A. Products shall be in accordance with BMU Standard Specifications and Standard Details.
- B. 12 AWG, solid-strand, soft-drawn copper.
- C. Insulation: 0.045-inches minimum thickness, color blue.
- D. Tracer Wire Box
  1. Tracer wire boxes shall allow for connection to locating equipment without removal of the lid.
  2. Cast iron lids shall be painted blue for water and labeled 'WATER'.

## 2.09 THRUST BLOCKING

- A. Install in conformance with BMU Specifications and standard details.

# PART 3 EXECUTION

## 3.01 GENERAL

- A. Conform to BMU Standard Specifications, Design Standards and Standard Details.

### 3.02 SERVICE INTERRUPTIONS

- A. Service interruptions are not permitted until approved by the Owner.
- B. Notify Owner at least 14 days in advance of any service interruption.
- C. Night or weekend water shutdowns may be required to minimize service disruption.

### 3.03 TRAFFIC CONTROL

- A. Traffic control shall be the responsibility of the Contractor.
- B. Provide in conformance to with the most current edition of the Manual of Uniform Traffic Control Devices (MUTCD).
- C. No separate payment will be provided for traffic control, unless indicated in the Drawings and included in the bid form.

### 3.04 INSTALLATION OF PIPE

- A. General: Conform to the latest revision of AWWA C605 and the installation instructions provided by the manufacturer. Complete utility trenching in accordance with Section 31 2300 – Excavation and Fill.
- B. Comply with the most current edition of OSHA Excavation Safety Standards.
- C. In accordance with the law, the Contractor shall request utility locates from South Dakota One Call prior to ground disturbances.
- D. Uncover utilities to verify horizontal and vertical alignment in advance of trenching.
- E. Excavate as necessary to maintain required cover and provide bedding as specified.
- F. Minimum cover depth over any water pipe (mains or services) shall be no less than 6.5 feet.
- G. Written approval must be provided by the Owner / Owner's Representative for any variance in the required cover depth.
- H. No pipe or appurtenances shall be laid in water or when trench conditions are unsuitable for safe work.
- I. Temporarily cap or plug pipe at the end of each day or during interruptions in work to prevent water, debris, and animals from entering the pipe.
- J. Clean gasket and spigot and apply gasket lubrication as recommended by the manufacturer. The lubricant shall be approved for used with potable water.
- K. Insert spigot into bell end. Utilize reference marks on pipe to avoid over insertion.
- L. Install tracer wire and appurtenances.
- M. Place sufficient chlorine tablets or chlorine powder in the water main as it is installed as required by the most current edition of AWWA C651 disinfection standards.
- N. Monitor weather forecasts and take appropriate measures to minimize flooding potential, protect construction progress, and minimize the transport of sediment leaving the site.
- O. Remove excavated material that is unsuitable for re-use from site.
- P. Maintain vertical separation of 18-inches minimum between the sanitary sewer main and the water main.

### 3.05 MECHANICAL JOINTS

- A. Install per manufacturer's recommendations / instructions.

- B. Clean and lubricate the socket and plain end of the fitting.
- C. Place joint restraint gland and gasket on the pipe.
- D. Insert the pipe into the socket and press the gasket into the recess.
- E. Install bolts and nuts to connect the joint restraint gland to the mechanical joint. Maintain the same distance between the gland and face of the flange by tightening the bolts in an alternating fashion. Tighten to supplier specified torque.
- F. Tighten the torque limiting twist off nuts until all wedges are in full contact with the pipe surface. Tighten in an alternating fashion until all torque nuts have been twisted off.

### 3.06 CONCRETE THRUST BLOCKS

- A. Poured or precast concrete thrust block per BMU Standard Specifications and Standard Plates.
- B. Only concrete thrust blocks will be acceptable.
- C. Avoid covering joints, bolts, nuts, or fittings with concrete.

### 3.07 DEWATERING

- A. Dewatering is the Contractor's responsibility.
- B. Review geotechnical exploration report if available.
- C. Dispose of groundwater is a safe matter approved by the South Dakota Department of Agriculture and Natural Resources (SDDANR).
- D. Water may not, in any case, be directed into any sanitary sewer system.
- E. No separate payment will be provided for dewatering.

### 3.08 BEDDING, BACKFILL AND COMPACTION

- A. Pipe bedding is required on all water piping in accordance with BMU Specifications, Standard Details and the details in the plans.
- B. Place specified bedding material completely under pipe haunches in uniform layers.
- C. Hand (shovel) tamp along pipe within haunch zone to provide a solid pipe foundation, completely free of voids.
- D. Place backfill in uniform loose lifts not to exceed 12-inches prior to compaction. Complete compaction and required testing prior to placing next layer.
- E. Topsoil may not be used to backfill any trench. Utilize acceptable onsite material only.
- F. Compaction of backfill shall be minimum 95% Standard Proctor density and from 1% above to 4% below optimum moisture content.
- G. Avoid compaction directly over the pipe that may damage the system.
- H. In the upper 3-feet of the subgrade, compaction shall be minimum 97% Standard Proctor density and from 1% to 4% below optimum moisture content.
- I. Drying operations shall be performed as needed to meet the required moisture conditions.

### 3.09 HYDROSTATIC PRESSURE TEST

- A. General: Conform to BMU Standard Specifications, unless modified herein.

- B. Test pressure equal to 120 psi on the gauge for a period of two (2) hours, and the segment of pipe to be tested shall not exceed 1,200 lineal feet.
- C. Owner's onsite representative and utility company shall observe the pressure gauge periodically throughout the test and before acceptance of the job.
- D. Contractor shall document that all valves are opened along the section of pipe being tested.
- E. At the conclusion of the test, the hydrant that is farthest from the gauge location shall be opened to relieve pressure. This shall be done in the presence of the onsite and/or utility company representative.
- F. Contractor is responsible for providing all equipment and labor to perform the required testing.
- G. Testing is considered incidental to the water main construction, and no separate payment will be made.
- H. Contractor shall provide documentation and report of testing, including test pressure, duration, pressure drop, allowable leakage, and make up water to regain pressure.

### 3.10 DISINFECTION

- A. General: Conform to BMU Standard Specifications, local and state standards.
- B. Passing tests are required prior to opening any valves. Signed documentation of passing tests from the testing agency must be provided to the Owner / Owner's Representative.
- C. Contractor shall be responsible for any costs associated with bacteria testing.

### 3.11 CONDUCTIVITY

- A. Conductivity testing will be required by the Contractor.
- B. Test all lines, including hydrant leads, water services, and stubs.
- C. The locating representative must be onsite and observe the conductivity test to verify locating needs.
- D. If the tracer wire system does not function as intended, the Contractor must repair the system to the satisfaction of the Owner, utility locator and Engineer.

### 3.12 DISPOSAL

- A. Disposal of all waste materials shall be in a legal manner offsite. Burial of waste materials is not permitted.
- B. The word 'Remove' or 'Removal' in the plans shall include physically removing and offsite disposal of removed materials.
- C. The Contractor may not abandon pipe in-place unless specifically noted in the plans.

## END OF SECTION

## **SECTION 33 3100**

### **SANITARY UTILITIES**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. This Section includes sanitary sewer piping and components outside of any building footprint.

##### **1.02 REFERENCES**

- A. Brookings Municipal Utilities (BMU) Specifications – Standard Specifications for Sanitary Sewer Main Construction (current edition)
- B. BMU Standard Plates for Sewer Main Construction (current edition)
- C. BMU Sanitary Sewer Collection Design Standards (current edition)
- D. South Dakota State University (SDSU) Design Standards (current edition)

##### **1.03 SUBMITTALS**

- A. Submit product data and technical information on the following items:
  - 1. Pipe, pipe bedding, fittings, transition couplings, manholes and tracer wire systems.
  - 2. Other items related to the sanitary sewer system indicated in the Drawings.

#### **PART 2 PRODUCTS**

##### **2.01 GENERAL**

- A. General: All products shall be consistent with the specifications and acceptable to the utility company.

##### **2.02 PSM POLY VINYL CHLORIDE (PVC) PIPE (4"-15") AND FITTINGS**

- A. Conform to the most current edition of ASTM D-3034, Type PSM.
- B. Less than 14-feet bury depth: SDR-35
- C. Greater than 14-feet depth and for sewer service risers: SDR-26
- D. Gaskets shall be in conformance with ASTM F-477 and must utilize the Rieber joining system.
- E. Design: Bell-end grooved for integral gasketed joint.
- F. Marking: Each pipe shall indicate pipe diameter, manufacturer, wall thickness, PVC cell classification, and specification ASTM D-3034.
- G. Bends are not allowed on sanitary sewer mains, unless written approved is provided by the Owner and Engineer. Bends greater than 45° are not allowed on any sewer service. Spigot end of the pipe shall be marked for "pipe home".

##### **2.03 SERVICE WYES**

- A. Wyes that have same size main and branch will not be allowed.

#### 2.04 TAPPING SADDLES

- A. Tapping saddles shall be Inserta Tee as manufactured by Inserta Fittings Company or approved equal.

#### 2.05 CAPS AND PLUGS

- A. PVC caps and plugs shall be gasketed or solvent weld capable of allowing for the Low Flow Air Testing. Caps or plugs that do not hold air and prevent passing the leakage testing will require removal and replacement as necessary to provide passing tests.

#### 2.06 PIPE COUPLING – DISSIMILAR MATERIAL

- A. Shielded elastomeric sleeve with incorporating stainless steel tensioning bands.
- B. Stainless steel shear ring required, minimum 0.011" thickness.
- C. Conforming to ASTM C1173.
- D. Clamp style and reducing couplings are not allowed.
- E. Approved Manufacturer: Fernco, Inc. - Strong Back RC Series Repair Coupling or approved equal.

#### 2.07 PIPE COUPLING – PVC TO PVC

- A. Rigid, PVC molded SDR 35 gasket joint repair sleeve, constructed to meet ASTM D3034 requirements.
- B. Gasketed, hub by hub style fitting with no center stop.
- C. Manufactured to slide over PVC sewer pipe ASTM D3034 SDR 35 or SDR 26.
- D. Couplings shall bear the manufacturer's identifying mark and size.
- E. Approved Manufacturer: GPK Products, Harrington Corporation, Multi Fitting or approved equal.

#### 2.08 PIPE BEDDING

- A. General: Conform to BMU Standard Specifications for material type and gradation.
- B. Pipe bedding shall consist of ¼" x ¾" clean angular crushed rock.
- C. Pipe bedding will be required on all sanitary main and service piping.
- D. Unless included in the bid form, pipe bedding material shall be incidental to the unit bid price for the piping, and no separate payment will be made.

#### 2.09 TRACER WIRE SYSTEM

- A. Products shall be in accordance with BMU Standard Specifications and Standard Details.
- B. 12 AWG, solid-strand, soft-drawn copper.
- C. Insulation: 0.045-inches minimum thickness, color green
- D. Tracer wire boxes shall be spaced no more 1,000 feet apart and at the termination points of the tracer wire system.

#### 2.10 SANITARY MANHOLE

- A. Conform to BMU Standard Specifications.

- B. Precast reinforced concrete manhole sections conforming to ASTM C478. Barrel sections shall be gasketed to assure watertight joints.
- C. In addition to the gasket, a preformed butyl rubber rope gasket shall be installed between each precast section. The gasket shall conform to Federal Specifications SS-S-210A and AASHTO M-198. RAM-NEK and Kent Seal are preapproved manufacturers.
- D. External joint seals meeting BMU Standard Specifications are required at each joint.
- E. Full depth lift holes are not permitted.
- F. Integral base and lower barrel section poured monolithically.
- G. Precast bench and inverts are required. Inverts must be smooth as possible and provide an uninterrupted flow through the manhole, without drops or restrictions which could lead to build-up of solid waste.
- H. Doghouse type construction with field poured inverts are not allowed, unless written approval is provided by the Engineer.
- I. Size: 48" inside diameter, unless indicated in Drawings or required for structural integrity.
- J. Adjustment Rings
  - 1. HDPE adjustment rings as provided by the manufacturer and matching the opening diameter.
  - 2. No shims or other leveling devices.
- K. Frame and Lid
  - 1. Conform to ASTM A48, Class 35B
  - 2. All covers shall be marked "SEWER" (preferred) or "SANITARY SEWER"
  - 3. Covers shall contain self-sealing gaskets and concealed pick holes.
  - 4. Frames and lids shall be as specified in the Drawings and BMU Standard Plates.
- L. Drop manholes shall comply with BMU Standard Specifications and Standard Plates.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. Conform to BMU Standard Specifications, Design Standards and Standard Details.

#### **3.02 SERVICE INTERRUPTIONS**

- A. Service interruptions are not permitted until approved by the Owner.
- B. Notify Owner at least 14 days in advance of any service interruption.
- C. Night or weekend water shutdowns may be required to minimize service disruption.

#### **3.03 TRAFFIC CONTROL**

- A. Traffic control shall be the responsibility of the Contractor.
- B. Provide in conformance to with the Manual of Uniform Traffic Control Devices (MUTCD).
- C. No separate payment will be provided for traffic control, unless indicated in the Drawings and included in the bid form.

#### **3.04 TRENCHING**

- A. Comply with the most current edition of OSHA Excavation Safety Standards.

- B. In accordance with the law, the Contractor shall request utility locates from South Dakota One Call prior to ground disturbances.
- C. Uncover utilities to verify horizontal and vertical alignment in advance of trenching.
- D. Excavate as necessary to maintain required cover and provide bedding as specified.
- E. Conform to Section 31 2300 – Excavation and Fill.

### 3.05 DEWATERING

- A. Dewatering is the Contractor's responsibility.
- B. Review geotechnical exploration report if available.
- C. Dispose of groundwater is a safe matter approved by the South Dakota Department of Environment and Natural Resources (SDDENR).
- D. Water may not in any case be directed into any sanitary sewer system.
- E. No separate payment will be provided for dewatering, unless indicated in the Drawings and included in the bid form.

### 3.06 BYPASS PUMPING

- A. Contractor shall determine if bypass pumping is required to complete the work.
- B. Contractor shall supply a bypass pumping plan for approval by the Owner and Owner's Representative. The Contractor will be responsible for the design, installation and operation of the bypass system.
- C. The plan shall provide for continuity of the sanitary sewer collection system. No interruptions shall be allowed.
- D. Sewage may not be directed or leak onto the ground or outside of the collection system.
- E. No separate payment will be provided for bypass pumping, unless indicated in the Drawings and included in the bid form.

### 3.07 INSTALLATION OF PIPE

- A. General: Conform to the latest revision of ASTM C2321 and the installation instructions provided by the manufacturer. Complete utility trenching in accordance with Section 31 2300 – Excavation and Fill.
- B. Install pipe starting on the downstream and working upstream.
- C. Place bell end upstream and spigot end downstream.
- D. Unless indicated in the Drawings, the alignment shall be straight between structures with a constant grade. Visual changes in alignment or grade shall be cause for rejection.
- E. At grade stakes shall be provided.
- F. A laser beam system shall be used to maintain alignment and grade.
- G. Inspect each pipe prior to installation. Pipe that is damaged shall be rejected and removed from the site.
- H. No pipe or appurtenances shall be laid in water or when trench conditions are unsuitable for safe work.
- I. Temporarily cap or plug pipe at the end of each day or during interruptions in work to prevent water, debris, and animals from entering the pipe.

- J. Clean gasket and spigot and apply gasket lubrication as recommended by the manufacturer.
- K. Insert spigot into bell end. Utilize reference marks on pipe to avoid over insertion.
- L. At locations specified in the Drawing, install tracer wire and appurtenances.
- M. Monitor weather forecasts and take appropriate measures to minimize flooding potential, protect construction progress, and minimize the transport of sediment leaving the site.
- N. Remove excavated material that is unsuitable for re-use from site.
- O. Maintain vertical separation of 18-inches minimum between the sanitary sewer main and the water main.

### 3.08 TRACER WIRE SYSTEM

- A. General: Conform to BMU Standard Specifications, unless modified herein.
- B. Install on all sanitary sewer mains and service lines.
- C. Place wire along lower quadrant of pipe. Do not place pipe directly on wire.
- D. Install ground rods adjacent to connections to the existing piping.
- E. Connect tracer wire to terminal box at each manhole.
- F. Install terminal box directly above the end of each service stub.
- G. Terminal boxes shall be placed no more than 1,000-feet apart or as indicated on the drawings.
- H. All underground splices shall be inspected prior to backfilling.
- I. Complete conductivity testing as indicated herein.

### 3.09 BEDDING, BACKFILL AND COMPACTION

- A. Pipe bedding is required on all sanitary piping in accordance with BMU Standard Specifications, Standard Plates and the details in the plans.
- B. In poor trench conditions, the Contractor shall install trench stabilization material conforming with BMU Standard Specifications. The use of trench stabilization material will not eliminate the need for pipe bedding material.
- C. Place specified bedding material completely under pipe haunches in uniform layers.
- D. Hand (shovel) tamp along pipe within haunch zone to provide a solid pipe foundation, completely free of voids.
- E. Place backfill in uniform loose lifts not to exceed 12-inches prior to compaction. Complete compaction and required testing prior to placing next layer.
- F. Topsoil may not be used to backfill any trench. Utilize acceptable onsite material only.
- G. Compaction of backfill shall be minimum 95% Standard Proctor density and from 1% above to 4% below optimum moisture content.
- H. Avoid compaction directly over the pipe that may damage the system.
- I. In the upper 3-feet of the subgrade, compaction shall be minimum 97% Standard Proctor density and from 1% to 4% below optimum moisture content.
- J. Drying operations shall be performed as needed to meet the required moisture conditions.

### 3.10 MANHOLE INSTALLATION

- A. Furnish and install manhole as indicated in the Drawings or in BMU Standard Plates.
- B. Set base section and all other manhole sections plumb with a maximum out of plumb of 1/4-inch.
- C. Install external joint seal at each joint.
- D. Prevent the entrance of dirt and debris. Immediately remove all materials that enter the manhole during construction.
- E. Cut pipe to provide connection as shown in the Drawings and BMU Standard Plates.
- F. Connect pipes manhole with stainless steel bands provided with manhole boot.
- G. Grout around pipes as shown in the Drawings and BMU Standard Plates.

### 3.11 MANHOLE ADJUSTMENT

- A. Adjustment of the manhole castings to finish grade shall be completed directly prior to placement of the final lift of asphalt.
- B. All adjustments shall be made in conformation with BMU Standard Specifications and Standard Plates.
- C. Manhole lids shall be set ¼" to ½" below the elevation of the proposed new pavement or existing ground. Castings set outside of this tolerance shall be re-adjusted at no cost to the Owner.
- D. Manhole inserts are not an acceptable method of raising the manhole and will not be allowed.
- E. In no case shall a manhole casting be left above the adjacent surfacing through winter. Damage caused by snow removal equipment shall be repaired at the Contractor's expense.

### 3.12 LOW PRESSURE AIR TEST

- A. Perform in accordance with ASTM F1417 and BMU Standard Specifications.
- B. Repair of leaks may require the removal and replacement of sanitary sewer manholes.
- C. The use of grout or pipe couplings to repair leaks will not be allowed.

### 3.13 PIPE DEFLECTION TEST

- A. General: Conform to BMU Standard Specifications.
- B. Deflection tests shall be performed by the Contractor on all PVC sanitary sewer mains.
- C. The Contractor will be responsible for contacting the Owner and / or Engineer to observe all tests for documentation.

### 3.14 CONDUCTIVITY

- A. Conductivity testing will be required by the Contractor.
- B. Test all tracer wire systems.
- C. The locating representative must be onsite and observe the conductivity test to verify locating needs.
- D. If the tracer wire system does not function as intended, the Contractor must repair the system to the satisfaction of the Owner, utility locator, and Engineer.

### 3.15 DISPOSAL

- A. Disposal of all waste materials shall be in a legal manner offsite. Burial of waste materials is not permitted.
- B. The word 'Remove' or 'Removal' in the plans shall include physically removing and offsite disposal of removed materials.
- C. The Contractor may not abandon pipe in-place unless specifically noted in the plans.

**END OF SECTION**

## **SECTION 33 4000**

### **STORM DRAINAGE UTILITIES**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. This Section includes storm water drainage piping, structures and miscellaneous appurtenances outside of any building envelop.

##### **1.02 REFERENCES**

- A. South Dakota Department of Transportation (SDDOT) Standard Specifications for Roads & Bridges, 2015 Edition, including all subsequent revisions.
  - 1. Section 450 – Pipe Culverts
  - 2. Section 670 – Drop Inlets
  - 3. Section 560 – Precast and Pretensioned Prestressed Concrete
  - 4. Section 831 – Drainage Fabric
  - 5. Section 990 – Pipe Culverts and Drainage Tubing
- B. South Dakota State University Design Standards (current edition)
- C. City of Sioux Falls, SD Standard Plates – Sections 450 and 650.

##### **1.03 SUBMITTALS**

- A. Submit product data and technical information on the following items:
  - 1. Pipe, gaskets, pipe bedding, fittings, storm manholes, inlets, castings, and other storm water structures.
  - 2. Other items related to the storm sewer system indicated in the Drawings.

#### **PART 2 PRODUCTS**

##### **2.01 GENERAL**

- A. General: All products shall be consistent with the SD DOT Standard Specifications, unless indicated herein.

##### **2.02 POLY VINYL CHLORIDE (PVC) PIPE AND FITTINGS**

- A. Conform to the latest revision of ASTM D3034, SDR 26.
- B. Gasketed joints conforming to ASTM D3212 and ASTM F-477.
- C. PVC Pipe Coupling: Shielded elastomeric sleeve with incorporating stainless steel tensioning bands.
  - 1. Stainless steel shear ring required, minimum 0.011" thickness.
  - 2. Conforming to ASTM C1173.
  - 3. Clamp style and reducing couplings are not allowed.
  - 4. Approved Manufacturer: Fernco, Inc. - Strong Back RC Series Repair Coupling or approved equal.

## 2.03 REINFORCED CONCRETE PIPE (RCP) AND FITTINGS

- A. General: Conform to ASTM C76.
- B. Pipe Joints: Bell and spigot conforming to ASTM C361.
- C. Gaskets: Watertight gaskets conforming to ASTM C443.
- D. Pipe Class: As indicated on the Drawings or Class 3 if not indicated.
- E. Markings: Include manufacturer name, date of casting, pipe class, and specifications.

## 2.04 PIPE BEDDING

- A. General: Conform to BMU Standard Specifications for material type and gradation.
- B. Pipe bedding will be required on all storm and drainage piping.

## 2.05 STORM MANHOLES

- A. Precast reinforced concrete manhole sections conforming to ASTM C478. Barrel sections shall be gasketed to assure watertight joints conforming to ASTM C443.
- B. Manhole must be precast concrete. Brick or concrete block manholes are not acceptable.
- C. The manufacturer, date cast, and structure name shall be clearly marked on the inside of each precast section.
- D. Sections damaged during transport, hauling or placement will be rejected.
- E. In addition to the gasket, a preformed butyl rubber rope gasket shall be installed between each precast section. The gasket shall conform to Federal Specifications SS-S-210A and AASHTO M-198. RAM-NEK and Kent Seal are preapproved manufacturers.
- F. Full depth lift holes are not permitted.
- G. Size: 48" inside diameter, unless indicated in Drawings or required for structural integrity.
- H. Adjustment Rings
  - 1. HDPE adjustment rings as provided by the manufacturer and matching the opening diameter.
  - 2. No shims or other leveling devices.
- I. Frame and Lid
  - 1. Conform to ASTM A48, Class 35B
  - 2. All solid covers shall be marked "STORM" or "STORM SEWER"
  - 3. Frames and lids shall be as specified in the Drawings or standard details.

## 2.06 DROP INLETS

- A. Conform to Sections 670 of the SD DOT Standard Specifications
- B. Conform to the details in the Drawings and the SD DOT Standard Plates.
- C. Provide castings as detailed and/or specified.
- D. Design – Contractor is responsible for have drop inlets and lids designed and detailed by a Professional Engineer, experienced in precast concrete design.

## 2.07 GROUT

- A. Use SD DOT approved grout for pipe connections at drop inlets or manholes.
- B. Commercially available non-metallic, non-shrink grout.

- C. Consisting of one-part Portland cement and two parts sand, by weight.
- D. Water/Cement Ratio 0.50 +/- 0.05
- E. Minimum 28-day compressive strength shall be 4500 psi.
- F. Conform to the requirements of ASTM C1107.

#### 2.08 PVC DRAIN BASINS

- A. Manufactured from PVC pipe stock.
- B. Integral water tight connection (ASTM D3212) to connecting pipes.
- C. Flexible elastomeric seals conforming to ASTM F477.
- D. All drain basins must be delivered to the site with at least one-foot (1') additional height than specified in the plans. The Contractor will be required to field cut the inlet to appropriate grade.
- E. Frame and Grate
  - 1. See detail(s) in the drawings.
  - 2. Ductile iron matching the basin diameter and recommended for use with the supplied basin.
  - 3. A circular ductile iron flange on the bottom of the frame shall closely match the diameter of the PVC basin and provide a well-fitting installation.
  - 4. Designed for H2O loading.
- F. Approved manufacturer: Nyloplast or approved equal.

### PART 3 EXECUTION

#### 3.01 GENERAL

- A. Conform to SD DOT Standard Specifications.

#### 3.02 TEMPORARY DRAINAGE

- A. Temporary drainage throughout construction is the Contractor's responsibility.
- B. Contractor shall be aware of existing drainage conditions and facilities, and shall provide for adequate drainage during all phases of construction.
- C. Damage caused by improper temporary drainage facilities shall be repaired at the Contractor's expense and to the satisfaction of the Owner / Owner's Representative.
- D. It is expected that the Contractor will closely monitor weather forecasts. If a rain event is anticipated, appropriate measures shall be taken to minimize flooding potential, protect construction progress, and minimize transport of sediment from leaving the site.

#### 3.03 TRAFFIC CONTROL

- A. Traffic control shall be the responsibility of the Contractor.
- B. Provide in conformance to with the Manual of Uniform Traffic Control Devices (MUTCD).
- C. No separate payment will be provided for traffic control, unless indicated in the Drawings and included in the bid form.

#### 3.04 TRENCHING

- A. In accordance with the law, the Contractor shall request utility locates from South Dakota One Call prior to ground disturbances.
- B. Uncover utilities to verify horizontal and vertical alignment in advance of trenching.
- C. Notify Owner / Owner's Representative of any utility conflict.
- D. Excavate as necessary to maintain required cover and provide bedding as specified.
- E. Conform to Section 31 2300 – Excavation and Fill.

### 3.05 DEWATERING

- A. Dewatering is the Contractor's responsibility.
- B. Review geotechnical exploration report if available.
- C. Dispose of groundwater is a safe matter approved by the South Dakota Department of Environment and Natural Resources (SDDENR).
- D. Water may not, in any case, be directed into any sanitary sewer system.
- E. No separate payment will be provided for dewatering, unless indicated in the Drawings and included in the bid form.

### 3.06 PIPE INSTALLATION

- A. Install pipe starting on the downstream and working upstream.
- B. Place bell end upstream and spigot end downstream.
- C. Install pipe to alignment and grade indicated in the Drawings and staked in the field.
- D. Unless indicated in the Drawings, the alignment shall be straight between structures with a constant grade. Visual changes in alignment or grade shall be cause for rejection.
- E. At grade stakes shall be provided.
- F. A laser beam system shall be used to maintain alignment and grade.
- G. Inspect each pipe prior to installation. Pipe that is damaged shall be rejected and removed from the site.
- H. Jointing
  - 1. Join pipe in accordance with the manufacturer's recommendations.
  - 2. Avoid damaging gasket, over insertion, or misalignment.
  - 3. Remove all dirt and clean gasket prior to insertion.
  - 4. Pipe sections shall be adjoined such that the ends are fully entered and the inner surfaces are reasonably flush and even.
- I. Lift holes (RCP) shall be plugged with grout or approved mastic with high strength adhesion.
- J. Avoid construction traffic over the trench that may result in damage to the pipe.

### 3.07 BEDDING, BACKFILL AND COMPACTION

- A. Pipe bedding is required on all storm and drainage piping in accordance with the Standard Details and the details in the plans.
- B. Place specified bedding material completely under pipe haunches in uniform layers.
- C. Hand (shovel) tamp along pipe within haunch zone to provide a solid pipe foundation, completely free of voids.

- D. Place backfill material in uniform loose lifts not to exceed 12-inches prior to compaction. Complete compaction and required testing prior to placing next layer.
- E. Utilize only acceptable onsite backfill material. Do not place topsoil as backfill.
- F. Compaction of backfill shall be minimum 95% Standard Proctor density and from 1% above to 4% below optimum moisture content.
- G. Avoid compaction directly over the pipe that may damage the system.
- H. In the upper 3-feet of the subgrade, compaction shall be minimum 97% Standard Proctor density and from 1% to 4% below optimum moisture content.
- I. Drying operations shall be performed as needed to meet the required moisture conditions.

### 3.08 MANHOLE OR INLET INSTALLATION

- A. Perform excavation as required.
- B. Place precast concrete base section on compacted subgrade and bedding.
- C. Set and verify that the precast base is plumb in all directions.
- D. All pipes entering the structure must be cut with a concrete saw to provide a clean, smooth pipe surface, that is nearly flush with the inside wall of the structure.
- E. All pipes shall be grouted on the inside and outside of the manhole or inlet to provide a watertight, structural, smooth connection. Grout shall entirely fill all voids between the pipe and precast structure.
- F. Pour inverts conforming to the inlet and outlet pipes, allowing for uninterrupted flow. Poured inverts shall match the shape of the bottom 1/3 of the pipe but may not reduce the flow area.
- G. Remove all forms, dirt and debris from structures after installation and prior to final inspection and acceptance.
- H. Install adjusting rings and casting to final grade.

### 3.09 CONNECTION TO EXISTING STORM STRUCTURES

- A. Cut necessary openings into existing structures in a neat and workmanlike manner.
- B. Connections shall be watertight.
- C. All connections shall be made in manner to avoid obstructing the flow area of the storm sewer.

### 3.10 CONNECTION – PIPE TO PIPE

- A. Make pipe to pipe connections in a neat workmanlike manner.
- B. Core drill receiving pipe as needed to make the connection.
- C. Install InsertaTee or other approved connecting fitting in accordance with the manufacturer's recommendations.
- D. Document location of connection and allow for visual inspection by the Owner's Representative.

### 3.11 GROUT

- A. Mix grout in accordance with supplier's recommendations.

- B. Grout around pipes and doghouses, both inside and outside to provide a watertight connection. Any visual groundwater inflow may constitute rejection.
- C. Allow for testing of grout for conformance.

### 3.12 PVC DRAIN BASIN

- A. Install basin per manufacturer's recommendations, unless more stringent specifications are included herein.
- B. Install granular bedding to provide a level compacted base for the drain basin.
- C. Backfill basin with granular material in well compacted uniform lifts in accordance with ASTM D2321.
- D. Avoid damage to the connecting pipes and basin during installation and compaction. Any materials damaged during installation shall be considered rejected and shall be replaced at the Contractor's expense.
- E. Cut drain basin to appropriate height for match finished grate, taking into consideration the height of the ductile iron frame and grate. The cut shall be straight and level. Avoid final cutting until finished grade has been approved by the Engineer.
- F. Install manufacture supplied frame and grate.

### 3.13 REMOVAL OF STORM PIPE OR STRUCTURES

- A. Any time the words 'Removal' or 'Remove' are used in the drawings, it shall mean removal of the pipe or structure in its entirety and shall include hauling and offsite disposal.
- B. The Contractor may not abandon pipe or structures in-place, unless specifically noted in the plans. If abandoned, the pipe or structure shall be filled entirely with flowable fill or sand.

### 3.14 DISPOSAL

- A. Disposal of all waste materials shall be in a legal manner offsite. Burial of waste materials is not permitted.

## END OF SECTION

**Brookings Municipal Utilities (BMU)**  
**Standard Specifications**  
**For**  
**Sanitary Sewer Main Construction**  
(City of Brookings)

Revision Date: February 18, 2020

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## **PART 1.0 - GENERAL**

### **1.1 SCOPE OF WORK**

- A. The Contractor shall furnish all the necessary labor, materials, equipment, tools, and supplies that are necessary to install a complete sanitary sewer system, as shown on the plans, standard plates and/or called for in the specifications or its addenda.

### **1.2 WARRANTY PERIOD**

- A. The corrective period of three (3) years shall commence from the BMU determined Substantial Completion date. The corrective period shall cover the contract as to workmanship and materials for a period of time as specified in the City of Brookings "EXCAVATING & BACKFILLING ON PUBLIC RIGHT-OF-WAY" Ordinance.
- B. The Contractor shall be held responsible for workmanship, materials, settling trenches or any other deficiencies in the sanitary sewer main system during the corrective period. The Contractor shall repair and/or replace all deficiencies in the sanitary sewer system during the three (3) years corrective period at no cost to the Owner. Any surface restoration costs incurred because of the repairing and/or replacing of deficiencies in the sanitary sewer system shall be borne by the Contractor.

### **1.3 CONTRACTOR LICENSE AND PERMITS**

- A. The Contractor shall be required to have any required licenses (sanitary sewer and water installation Contractor license or sanitary sewer and water installer license) for water/sewer installation or water/sewer repairing as stated in the South Dakota State Plumbing Code.
- B. The Contractor shall obtain an "EXCAVATION PERMIT" issued at no charge from the Brookings City Engineering Office before any water/sewer installation or water/sewer repairing will be allowed.
- C. The Contractor shall obtain any "DEWATERING PERMITS" required from local, state or federal agencies. The discharge area must be prior approved by the Engineer before initiating the dewatering.

### **1.4 BMU SANITARY SEWER SERVICE TAPPING FEES**

- A. Contractor shall be responsible for payment to BMU for all sewer tapping fees. Sewer tapping fees shall be charged to the Contractor at the cost identified on the BMU annually published "SERVICE CHARGES – WATER/SEWER" rate sheet.
  - 1. Upon completion of work, BMU will generate an invoice and bill accordingly for any BMU furnished & installed tapping tee (inserta tee) or saddles for making sanitary sewer taps.
  - 2. If the Contractor installs an in-line wye (preferred), or tapping tee (inserta tee), then a tapping fee will not be required.

## 1.5 QUALITY CONTROL

- A. Testing and/or retesting of materials because of nonconformance to the specified requirements shall be performed by an independent firm as per the instructions of the Engineer of Record.
- B. Payment for retesting performed during the Contract period and during the warranty period will be the responsibility of the Contractor.

## 1.6 SUBMITTALS

- A. The Contractor shall submit the number of copies that the contract requires plus one copy that the Engineer of Record will retain. The Contractor shall obtain shop drawing approval before any of the work related to that material is performed.
- B. Shop drawings and data shall be submitted for, but not be limited to, the following items:
  - 1. Sanitary sewer manholes, pipe, pipe fittings, bedding material, stabilization material, road topping material, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.
  - 2. Sanitary sewer manhole shop drawings shall be submitted for each sanitary sewer manhole and shall indicate the sections to be used with sizes and heights. A drawing showing the profile of the sanitary sewer manhole must be submitted and shall be detailed to scale to show all segments of the sanitary sewer manhole in a profile view.
- C. The Contractor shall submit appropriate documentation to the Engineer of Record for any materials not listed in these specifications. The Engineer of Record may forward any shop drawing to the BMU Engineer for consideration. Correspondence shall indicate any discrepancies between the BMU specification requirements and the Contractor provided submittal.
  - 1. BMU Engineer reserves the right to reject any and all materials that do not meet the requirements for sanitary sewer pipe and appurtenances as indicated in these standard specifications.
- D. If a Temporary Sanitary Sewer Bypass System is deemed necessary by the Engineer of Record, the Contractor shall submit a comprehensive Temporary Sanitary Sewer Bypass Plan to the BMU Engineer for approval.

## 1.7 TRAFFIC CONTROL

- A. The Contractor shall furnish, install and maintain any and all traffic control devices as required by the project plans. All traffic control devices shall be provided and installed according to the manual on "Uniform Traffic Control Devices" for streets & highways whenever applicable. The Federal Highway Administrator approves this manual as the National Standard.

## 1.8 GEOTECHNICAL REPORT

- A. In the event that a geotechnical report, prepared by a licensed South Dakota Professional Engineer, exists for the proposed project, the requirements of that report shall be strictly adhered to.
- B. Any requirements for, but not limited to compaction requirements, dewatering, testing frequency, the need for imported materials or trench stabilization included in the geotechnical report shall be followed regardless of the specific requirements in the following subsections.

**PART 2.0 - PRODUCTS****2.1 TRENCH STABILIZATION MATERIAL**

- A. In poor trench conditions, or if directed by the BMU Engineer's Representative, the Contractor shall be required to use trench stabilization consisting of 3/4-inch to 4-inch crushed angular, well-graded material.
- B. Larger crushed angular material may be required if deemed necessary by the BMU Engineer's Representative to stabilize the bottom of the trench.
- C. The use of trench stabilization material will not eliminate the need for pipe bedding material.

**2.2 PIPE BEDDING MATERIAL**

- A. Contractor shall use 1/4" x 3/4" clean angular crushed rock for pipe bedding, with the following minimum percentage gradation requirements:

*Table 1- Pipe Bedding Gradation*

<b>Sieve Size</b>	<b>Percentage Passing</b>
<b>1-inch</b>	100%
<b>3/4-inch</b>	85% to 100%
<b>1/2-inch</b>	15% to 85%
<b>#4</b>	0% to 15%

**2.3 IMPORTED ENGINEERED FILL MATERIAL**

- A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported engineered fill material for backfilling the sanitary sewer trench.
- B. Imported engineered fill material shall be a granular material conforming to requirements for "PIT RUN" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING", processed sand or gravel having a maximum particle size of 1-inch.

**2.4 IMPORTED CLAY MATERIAL**

- A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported clay backfill material for backfilling the sanitary sewer trench.
- B. Clay material is available from the Brookings Regional Landfill (605-693-3667). Contractor shall be responsible for contacting the landfill to determine the availability and cost of the material. Contractor shall be responsible for loading, hauling and placing the clay material.
- C. The moisture content of the imported clay material shall be 1 to 4% below the optimum moisture content at time of placing and compacting the material. The

Contractor shall be responsible for drying material to obtain the optimum moisture conditions.

## 2.5 AGGREGATE BASE MATERIAL

- A. Aggregate base material shall be provided at any location where a hard road surface (concrete or asphalt) will be placed over the sanitary sewer trench.
- B. The aggregate base material shall conform to requirements for "AGGREGATE BASE COURSE" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING".
- C. The 3/4-inch granular material, unless otherwise directed, shall conform to the following sieve analysis:

*Table 2- Imported Granular Material Gradation*

Sieve Size	Percentage Passing
<b>1-inch</b>	100%
<b>3/4-inch</b>	80% to 100%
<b>1/2-inch</b>	68% to 91%
<b>#4</b>	46% to 70%
<b>#8</b>	34% to 58%
<b>#40</b>	13% to 35%
<b>#200</b>	3% to 12%

## 2.6 GRAVEL SURFACING MATERIAL

- A. The gravel surfacing or road topping material shall conform to requirements for "GRAVEL SURFACING" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING".
- B. The 3/4-inch gravel surfacing material with a soil mortar or binder, unless otherwise directed, shall conform to the following sieve analysis:

*Table 3- Crushed Gravel Gradation*

Sieve Size	Percentage Passing
<b>3/4-inch</b>	100%
<b>#4</b>	50% to 78%
<b>#8</b>	37% to 67%
<b>#40</b>	13% to 35%
<b>#200</b>	4.0% to 15%

## 2.7 FLOWABLE FILL MATERIAL (K-CRETE)

- A. Flowable fill (K-Crete) shall be a controlled low strength concrete that is highly flowable without segregation. The concrete mix shall meet the following requirements:

Table 4- Flowable Fill Mix Design

Materials	Mix Design Parameters
<b>Cementitious Materials</b>	100 to 300 lbs
<b>Sand</b>	2000 to 3000 lbs
<b>Water</b>	Water to cement ratio = 1.0 to 1.5
<b>Air</b>	10 to 30 %
<b>Unit Weight</b>	110 to 125 lbs/ft <sup>3</sup>
<b>Slump</b>	8" Min
<b>Compressive Strength</b>	200 psi Max

## 2.8 POLY VINYL CHLORIDE (PVC) SANITARY SEWER MAIN PIPE

- A. Sanitary sewer pipe 4-inches in diameter and greater shall be poly Vinyl Chloride (PVC) with a gasket material. The pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, 12364-C or 13364-B.
- B. PVC sewer service and main pipe 12-inch and smaller shall be manufacturer in accordance with ASTM D3034, latest revision and be available with standard dimension ratio (SDR) of 35 and 26.
- C. PVC sewer main pipe 15-inch and larger shall be manufacturer in accordance with ASTM F679, latest revision and be available with standard dimension ratio (SDR) of 35 and 26.
- D. 4-inch and 6-inch PVC sewer service pipe shall be PVC Schedule 40 solid pipe when installed in same trench as water service. Pipe shall be iron pipe size (IPS) conforming to ASTM D1725 and ASTM D2665.
- E. All PVC pipe joints shall be gasketed, bell and spigot, push on type conforming to ASTM D3212. The bell shall consist of an integral wall section with a solid cross section elastomeric ring, factory assembled, securely locked in place to prevent displacement. Solvent cement joints will not be allowed for sanitary sewer pipe and fittings.
- F. Acceptable Manufacturers for sanitary sewer pipe shall be JM Eagle, Diamond or prebid BMU Engineer approved equal.

## 2.9 SANITARY SEWER FORCE MAIN PIPE

- A. All pipe for sanitary sewer pressure piping (force mains) shall meet the requirements of "POLYVINYL CHLORIDE (PVC) WATER MAIN PIPE" in the BMU Standard Specifications for Water Main.

## 2.10 TRACER WIRE FOR SANITARY SEWER FORCE MAIN

- A. All components of the tracer wire system shall meet the requirements of "TRACER WIRE FOR WATER MAINS" in the BMU Standard Specifications for Water Main. The only exceptions shall be that the tracer wire color shall be green.
- B. Tracer wire access point for sanitary sewer shall include a terminal block, cast iron collar and lockable lid. Terminal box shall be manufactured from high grade ABS rigid plastic (ASTM D1788) and have a magnet securely attached to be easily detected by magnetic locators. Locking mechanism shall secure the lid to the base

and be locked/unlocked with a pentagon wrench. Access point shall be designed so that when installed, the collar will be flush with the surface and contain the lid. Access point terminations shall be Snakehead Roadway access point as manufactured by Copperhead Industries or prebid BMU Engineer approved equal.

- C. The tracer wire terminal boxes shall be placed at no more than 1,000-feet apart from one another or as specified on the plan notes or drawings.

## 2.11 PIPE COUPLING

- A. Pipe coupling shall be designed for resistance to heavy earth loads and shear forces. Coupling shall be designed to a maximum test pressure of 4.3 psi and a maximum operating temperature of 140 degrees (F).
- B. Coupling shall utilize a gasket, clamps, shear ring and coupling. Pipe coupling shall be manufactured to conform to the performance requirements of ASTM C1173, latest revision. Clamps and bands shall be 316 stainless steel and available in two nut and bolt take-up points per band in 6-inch and larger sizes.
- C. Manufacture shall provide a wide range of coupling size to accommodate different pipe materials and associated sizes.
- D. All couplings shall bear the Manufacturer's identifying mark and size.
- E. Reducing couplings shall not be allowed. Reducer couplings will only be allowed for special situations as determined necessary by the BMU Engineer. Pipe coupling shall not be installed on reducers.
- F. Acceptable Manufacturers for couplings shall be Strong Back RC Series Repair Coupling as manufactured by Fernco Inc., Indiana Seal or prebid BMU Engineer approved equal.

## 2.12 POLY VINYL CHLORIDE (PVC) FITTINGS

- A. Provide fittings, including but not limited to cleanouts, wyes, caps, covers, bends, reducers and plugs, fabricated from PVC materials and having gasketed joints conforming to ASTM D3034 and ASTM F949.
- B. PVC fittings shall be provided to match the standard dimension ratio (SDR 35 and 26) of the pipe that the fitting is being installed on.
- C. Sanitary Sewer Service Cleanouts:
  - 1. Pipe for cleanouts shall be Schedule 40 PVC.
  - 2. Cleanout Cap and Cover shall be Neenah R1976 or prebid BMU Engineer approved equal. The cover shall be labeled "SEWER".
- D. All PVC caps and plugs shall be gasketed or solvent weld.
- E. Where reducers are necessary and approved for connections to existing service lines, reducers shall be eccentric type manufactured of approved pipe material.
- F. Bends greater than 45 degrees will not be allowed.
- G. Wyes with the same main line and branch line diameter will not be allowed (example: 4x4, 6x6, 8x8, etc.).

## 2.13 PRECAST SANITARY SEWER MANHOLE

- A. Precast concrete sanitary sewer manholes shall conform to ASTM Designation C478 with all current revisions. The wall thickness shall be a minimum of 5-inches with one cage reinforcing with a minimum of 0.12-square inches of reinforcement per lineal foot of wall. Sanitary sewer manholes shall be constructed without steps or ladders.
- B. Provide size and number of sanitary sewer manholes as indicated on project plans and bid form.
- C. The upper section of the sanitary sewer manhole shall be a concentric precast cone made expressly for this purpose providing a minimum diameter of 24-inch opening at the top. The offset or eccentric cone section shall not be allowed.
- D. Provide O-ring gaskets or continuous butyl rubber rope gasket for constructing watertight sanitary sewer manhole joints. The butyl rubber rope gasket shall conform to or exceed all requirements of Federal Specification SS-S-210A and AASHTO M-198. O-ring gaskets shall be manufactured by Hamilton Kent, Tylox Super Seal gasket, Press-Seal Gasket Corporation, RFS Seal or BMU Engineer approved Equal.
- E. Lift holes shall not extend through the sanitary sewer manhole walls on 48-inch diameter sanitary sewer manholes. Lift holes shall be filled with non-shrink grout.
- F. Non-shrink grout shall be a premixed compound consisting of no-metallic aggregate, cement, water reducing, and plasticizing agents. Grout shall have a minimum compressive strength of 2,400-psi in 48-hours and 7,000-psi in 28-days.
  1. Approved Manufacturers for the non-shrink grout shall be:
    - a. "Supreme Grout" – by Hanson Pipe and Products
    - b. "Crystex" – by L & M Construction Chemicals
    - c. "588 Non-Metallic, Nonshrink Grout" – by W.R. Meadows
    - d. "Master Flow 713" – by Master Builders
    - e. "Songrout" – by Sonneborn
    - f. "Five Star Grout" – U.S. Grout Corp.
    - g. or prebid BMU Engineer approved equal.
- G. On sanitary sewer manholes where the lift holes extend through the wall sections, a lift hole plug as manufactured by Press Seal Corporation or prebid BMU Engineer approved equal shall be installed at each lift hole and non-shrink grouted over the plug.
- H. All sanitary sewer manhole bench and inverts shall be manufacture pre-formed. Hand forming of sanitary sewer manhole bench and inverts will not be allowed on new sanitary sewer manholes, unless prior approved by the BMU Engineer.
  1. Bench and inverts may also be formed by using a bench and invert forming system as manufactured by Royal Environmental Systems, Press Seal, A-Lok or prebid BMU Engineer approved equal.

- I. Upon request from BMU, the Contractor and/or supplier shall supply BMU with a test report from an independent testing laboratory showing compliance with this specification.

#### 2.14 CAST-IN-PLACE SANITARY SEWER MANHOLE (DOGHOUSE)

- A. Cast-in-place concrete sanitary sewers are not allowed unless specifically called out for on project plans.
- B. Concrete used for poured sanitary sewer manhole bases, pipe cradles, or other monolithically poured structures shall conform to the requirements of Class M6 Section 462 of the "STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES OF THE SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION".
- C. Reinforcement bars for sanitary sewer manholes shall be structural grade, manufactured by the open hearth process from new billets. All bars shall be deformed and Grade 60.
- D. PVC Water stops for cast-in-place concrete sanitary sewer manhole base and wall sections shall be used on all joints associated with new pours. Provide a flat profile mechanical ribbed ends 7-inches wide, 5/16-inch minimum thickness for construction joints and use a split center bulb with mechanical ribbed ends measuring 9-inches wide by 1/2-inch minimum thickness for all expansion joints.
  1. Acceptable manufacturers for PVC water stops shall be Meadows Inc.; B.F. Goodrich Company; Progress Unlimited or prebid BMU Engineer approved equal.

#### 2.15 SANITARY SEWER MANHOLE CASTINGS

- A. All frame and covers shall be constructed with gray iron having a tensile strength of not less than 35,000 pounds per square inch. The frame and covers shall conform to ASTM A48, Class 35B. The castings shall be heavy-duty type, designed for H20 loading conditions. Frames shall be 7-inch in height.
- B. The castings shall be free from cracks, blowholes, porosity, shrinkage distortion, or other imperfections. They shall be true to pattern and free from warpage. The frame and covers shall fit together in a satisfactory manner. Machined bearing surfaces shall be provided to prevent rocking and rattling.
- C. All covers shall be supplied with concealed pick holes and shall have casted letter indicating "SANITARY SEWER."
- D. All covers shall be supplied from manufacture with pre-installed, glue-in, self-sealing type "T" gaskets. The gasket shall be installed in a machined groove and be continuous around the perimeter. The gasket material shall be oil resistant Nitrile (60 DURO) glued in the groove, and have a maximum swell of 90-percent when tested in accordance with ASTM D471 using ASTM No. 3 oil.
- E. Acceptable manufacturers for the manhole castings, including frame and lids shall be Deeter 1260, East Jordan Ironworks 1205, Municipal Castings 301-7, or a Neenah Foundry R-1733.

## 2.16 HDPE ADJUSTMENT RINGS

- A. Adjusting rings shall be manufactured from high density polyethylene (HDPE) as identified in ASTM D-1248 (Standard Specification for Polyethylene Plastic Molding and Extrusion Materials). Material properties shall be tested and qualified for usage in accordance with the ASTM Test Methods referenced in ASTM D-1248.
- B. The adjusting rings shall be sized to conform to a standard 24-inch sanitary sewer manhole opening.
- C. The HDPE adjusting rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers). The adjusting rings shall be tested to assure compliance with impact and loading requirements in accordance with the AASHTO Standard Specification for Highway Bridges.
- D. The adjusting rings shall meet and exceed the static load requirements of ASSHTO highway Bridge Specification HS-25 (21,280 lbs). The rings must withstand 1,000,000 plus full load cycles of 10-seconds or less duration. The rings must perform without failure to a minimum of 150-percent of these load values.
  - 1. Acceptable manufacturers for the HDPE adjustment rings shall be manufactured by Ladtech, Inc. or prebid BMU Engineer approved equal.
- E. HDPE adjustment rings shall be adhered to manhole section and adjoining adjustment rings using a trowelable form of Butyl Rubber Sealant. The material must meet or exceed the requirements of Federal Specification TT-S-001657, ASTM C-990 and AASHTO M-198.
  - 1. Acceptable manufacturers for the trowelable sealant shall be manufactured Pre-seal Gasket Corporation, EZ-STIK #3 or prebid BMU Engineer approved equal.

## 2.17 SANITARY SEWER MANHOLE BOOTS

- A. Sanitary sewer manhole boots for connecting pipes to the sanitary sewer manholes shall be a watertight flexible connection meeting the requirements of ASTM C923. The rubber boots shall be supplied with two stainless steel clamps for attaching the boot to the pipe. A stainless steel "power sleeve" shall be supplied for connecting the boot to the sanitary sewer manhole.
- B. Acceptable manufacturers for the sanitary sewer manhole boots shall be Press Seal Corporation, Type PSX or prebid BMU Engineer approved equal.

## 2.18 SANITARY SEWER MANHOLE EXTERNAL FRAME SEAL

- A. The seal (for the Sealing Systems, Inc. product) shall be a continuous band made of high quality EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 60-mils.
- B. Each unit shall have a 2-inch wide mastic strip on the top and bottom of the band. The mastic shall be non-hardening butyl rubber sealant with a minimum thickness of 3/16-inch and shall seal to the cone/top of the sanitary sewer manhole section and over the flange of the casting.

- C. Acceptable manufacturers for the external frame seal shall be Wrapid Seal as manufactured by CANUSA-CPS, Infi-shield Uni-Band as manufactured by Sealing Systems Inc., I/I Barrier by Strike Products, Internal/External Frame Seal as manufactured by Adaptor Inc., or prebid BMU Engineer approved equal.

- 1. Infi-shield Uni-Band as manufactured by Sealing Systems Inc. shall be the only product allowed in street pavement areas.

#### 2.19 SANITARY SEWER MANHOLE EXTERNAL JOINT SEAL

- A. The seal shall be made of a 6-inch wide, stretchable, self-shrinking, intra-curing based rubber with a minimum thickness of 30 mils.
- B. The adhesive side of the tape shall be coated with a cross-linked re-enforced butyl adhesive. The butyl adhesive shall be non-hardening sealant, with a minimum thickness of 30 mils.
- C. The butyl adhesive and the inward pressure exerted on the substrate shall prevent the intrusion of water and soil through the joint section of the manhole.
- D. Acceptable manufacturers for the external joint seal shall be Gator Wrap as manufactured by Infi-Shield or prebid BMU Engineer approved equal.

#### 2.20 SANITARY SEWER MANHOLE DROP ASSEMBLY

- A. The drop system shall include a plastic composite collection device that facilitates the controlled drop of effluent into the main stream flow of a sanitary manhole. The drop system permits easy inspection and cleaning without the need to enter the structure.
- B. The "A" size drop bowl has a 12-inch wide receptor bowl with a 4-inch or 6-inch outlet. The 4-inch bowl outlet will service a 6-inch sanitary sewer main and the 6-inch bowl outlet will service an 8-inch sanitary sewer main. The "B" size drop bowl has an 18-inch wide receptor bowl with an 8-inch or 10-inch outlet. The 8-inch bowl outlet will service a 10-inch sanitary sewer main and the 10-inch bowl outlet will service a 12-inch sanitary sewer main.
- C. Vertical pipe used in the drop assembly shall be the same material and pipe class as piping exterior to the manhole. Heavy wall pipe, SDR 26, shall be used if heavy wall pipe is used outside of the manhole.
- D. The clamping brackets and fasteners shall be adjustable and be manufactured from 316 stainless steel.
- E. Acceptable manufacturers for the drop system shall be the "Reliner Inside Drop System" as manufactured by Duran, Inc. or prebid BMU Engineer approved equal.

#### 2.21 SANITARY SEWER MANHOLE CONSTRUCTION PLATE MARKER

- A. Sanitary sewer manhole construction plate shall be fabricated from 1/2-inch plate steel. Plate shall be fabricated with 4-inch by 4-inch, 1/4-inch box tubing to provide stiffing capacity to plate. Provide a plate with a minimum diameter of 32-inches to provide adequate overlap with the manhole cover.

- B. Sealant shall be installed between the manhole plate and the top of the manhole to form a water tight seal.
- C. The sanitary sewer manhole construction plate marker shall be fluorescent orange in color and have three (3) bands of reflective tape installed on the top third of the marker. Acceptable manufactures for the construction plate marker shall be "Flex-Guide 300 Series" delineator post and base as manufactured by Davidson Traffic Control Products or prebid BMU Engineer approved equal.

## 2.22 SANITARY SEWER MANHOLE LINERS

- A. HDPE sanitary sewer manhole liners shall be used on sanitary sewer manholes which are required to be lined.
- B. The material used in the embedment liner and in all welding strips shall be a made from 97-98 percent virgin high-density polyethylene and 2-3 percent carbon black or pigmentation for the purpose of an otherwise specified color. Plasticizers shall not be added to the resin formulation. The material color shall be yellow, white, or off-white. Dark colors will not be acceptable.
- C. Embedment sheets for field installation shall be produced in rolls that are a minimum of 6.5-feet (2-m) in width with 2.0-mm thickness for precast concrete pipe and sanitary sewer manholes.
- D. Locking studs of the same material as that of the liner shall be integrally extruded with the sheet and have a minimum height of 0.40-inches (10-mm). The maximum distance between studs shall be 2.127-inches. A minimum of 39 studs per square foot shall be installed on the liner.
- E. Liner Physical Properties: All plastic embedment sheets and welding strips shall have the following physical properties when tested in accordance with the following table.

*Table 5- Sanitary Sewer Manhole Liner Properties*

Property	Test Method	Value
<b>Thickness (min)</b>	ASTM D 751	+/- 10%
<b>Density g/cm3 (min)</b>	DIN53479 / ASTM D 792	0.94
<b>Tensile Properties</b>	DIN53455 / ASTM D 638	
<b>Tensile Strength at Yield, lb/in2 (min)</b>		2,200
<b>Tensile Elongation at Break, % (min)</b>		600
<b>Tensile Strength at Break, lb/in2 (min)</b>		3,600
<b>Carbon Black Content, % (max)</b>	ASTM D 1603	2-3
<b>Dimensional Stability, %</b>	DIN 53515	+/- 2
<b>Linear Coefficient, in/in/oC</b>	ASTM D 696	1.2x10-4
<b>Service Temperature</b>		-70 to 1760F
<b>Stud Pull Out Strength (min)</b>		>4,300 psf

- F. Embedment sheets and welding strips shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material. The Engineer may reject any materials which may be defective.
- G. Liner shall have demonstrated good chemical resistance via testing in accordance with EPA 9090.

- H. Weld strips shall have good impact resistance, be flexible, and have an elongation sufficient to bridge up to 0.5-inch settling cracks, which may occur in the sanitary sewer manhole/pipe or in the joint after installation without damage to the strip. The lining shall be repairable at any time after installation in pipe, sanitary sewer manholes, or structures by methods approved and recommended by the Manufacturer.
- I. Supply of Material:
  - 1. Sanitary sewer manhole/pipe embedment sheets shall be supplied as pipe size sheets or tubes fabricated by shop welding the basic size sheets together. For tank containment structures, either roll goods or prefabricated panels shall be supplied. Shop welds shall be made by a butt weld and fusing the sheets together by a thermal process such as an extrusion weld, fusion weld, or equal, so as to produce continuous welded seams. Specimens taken from shop welded seams shall show no cracks or separations and shall be tested in tension. Each specimen shall withstand a minimum shear strength of 60-percent of parent tensile yield strength.
  - 2. During installation of the embedment sheet onto the forms, there shall be no cuts made within the liner for purposes such as strapping of sheet. If straps are utilized they shall be placed so that the straps are positioned between embedment studs. Sheets may be supplied in prefabricated, pipe sized tubular shaped sheets, ready to install onto the inner form, or roll goods having specified dimensions listed in the Materials and Dimensions section.
  - 3. Joint strips for pipe seaming shall be approximately 4-inches wide with a minimum width of 3.75-inches. Thickness of joint strips shall be 3.0-mm.
- J. The sanitary sewer manhole liner specified in this section shall be furnished by a Manufacturer who is fully experienced, reputable, and qualified in the manufacturing of the materials and who has in their employment a full-time field service representative with at least five years field experience. The sanitary sewer manhole liner shall be designed, constructed, and installed using techniques recommended by the Manufacturer.
- K. The Manufacturer of the lining shall attest to the successful use of its product as a lining for sanitary sewer pipes, sanitary sewer manholes or pump stations in sewage conditions, or other chemical environments recognized as corrosive or otherwise detrimental to concrete.
- L. Acceptable manufacturers for the sanitary sewer manhole liner Manufacturers shall be GSE Studliner as manufactured by GSE Lining Technologies, Inc., AGRU Sure-Grip as manufactured by AGRU America or prebid BMU Engineer approved equal.
- M. PVC T-Lock liner will be allowed on some structures where it is determined by the BMU Engineer to be acceptable. Specifications for the PVC T-Lock liner shall be supplied for each individual project. The sanitary sewer manhole liner specifications shall apply to PVC T-Lock liner where applicable when specified.

## 2.23 BACKFLOW PREVENTERS

- A. Backflow preventer or backwater valve shall be designed as sewage check valve to prevent water from flowing back from the wastewater collection system into a residence.
- B. Valve assembly shall include threaded cover to allow for access and valve flapper which seals closed while not in use. Flapper shall be installed into valve body via removable carrier and allow unrestricted, unidirectional flow.
- C. Valve body shall be adaptable to either shallow or deep bury installations and be designed in accordance with South Dakota Plumbing Code and ASME A112.14.1. Valve shall be made of PVC or ABS plastic and shall be solvent welded to sewer service piping.
- D. Acceptable manufacturers of backflow preventer shall be Oatley model 439XX, Sioux Chief 869 Series, IPS Corporation Model No. BWV4A, NDS Model 475P/R or engineer approved equal.

## 2.24 SANITARY SEWER SERVICE TAPPING TEE

- A. Provide a three piece service connection that consists of a PVC hub, rubber sleeve and stainless steel band. Connection shall be a compression fit into the cored wall of the mainline sewer pipe. Hub shall be made from heavy duty PVC material. Stainless steel clamping assembly shall be made from a minimum 301 grade stainless steel. Rubber sleeve and gasket shall meet the requirements of ASTM F477. Gasket shall be factory installed by the manufacturer.
- B. Service connections shall be available from the manufacture for a wide variety of pipe materials, including, PVC C900, C905, SDR 26 HWS, SDR 35, IPS/Sch 40 PVC and concrete pipe.
- C. Acceptable manufacturers for the sanitary sewer service connection for PVC sewer pipe shall be "Inserta Tee" as manufactured by Inserta Fittings Company or prebid BMU Engineer approved.

## 2.25 PIPE INSULATION

- A. Sanitary sewer main insulation shall be an extruded polystyrene board and meet the requirements of ASTM C578, Type IV. The minimum R-value shall be 5.0 as determined by ASTM C518. The minimum compressive strength shall be 25-psi as determined by ASTM D1621. The maximum water absorption shall be 0.1-percent by volume as determined by ASTM C272. The maximum water vapor permeability shall be 1.1-perm as determined by ASTM E96.
- B. Water main insulation shall be STYROFOAM™ Square Edge by the Dow Chemical Company, STYROFOAM™ Brand Scoreboard by the Dow Chemical Company, or prebid BMU Engineer approved equal.

## 2.26 ENCASEMENT PIPE - PVC

- A. Encasement pipe for sanitary sewer mains shall use restraint joint PVC pressure pipe. Restraint Joint PVC Pressure pipe shall be manufactured in accordance with

the dimensions, materials, quality control and markings specifications found in AWWA C900/C905.

- B. PVC Material shall conform to a minimum cell classification of 12454 as defined by ASRM D1784. The pipe compound is listed as standard grade material with a Hydrostatic Design Basis (HDB) of 4000 psi.
- C. Pipe system shall utilize a restrained joint utilizing a precision-machined groove on the pipe spigot and inside the pipe bell or coupling. A spline shall be inserted through an entry hole in the pipe bell, resulting in a continuous circumferential restrained joint that locks the pipe segments together.
- D. Pipe classes shall be as follows:

*Table 6- PVC Encasement Pipe Material*

Pipe Size	PVC Pipe Type
<b>4" – 12"</b>	C900 DR 18
<b>14" – 48"</b>	C905 DR 18

- E. All PVC pipe and gasket materials shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.
- F. Standard pipe laying length on 20 feet shall be provided unless otherwise specified on project plans.
- G. Acceptable Manufacturers are NAPCO Certa Lok , Certainteed Yelomine or prebid BMU Engineer approved equal.

## 2.27 ENCASEMENT PIPE - STEEL

- A. Steel casing pipe shall be ASTM A53 or ASTM A139 welded pipe with a minimum yield strength of 35,000 psi.
- B. Pipe shall be full circumference welded joint in accordance with AWS D1.1 to withstand excavation forces.
- C. Minimum wall thickness and diameter shall be provided as shown in the following table:

*Table 7- Steel Encasement Pipe Material*

Carrier Pipe Size	Carrier Pipe Type	Wall Thickness
<b>4" – 12"</b>	C900 PVC, DR 18	0.250"
<b>16"</b>	C905 PVC, DR 18	0.312"
<b>20"</b>	C905 PVC, DR 18	0.375"
<b>24"</b>	C905 PVC, DR 18	0.438"
<b>30"</b>	C905 PVC, DR 18	0.500"
<b>&gt;36"</b>	C905 PVC, DR 18	0.563"

## 2.28 CASING SPACERS

- A. Casing spacers shall be constructed of circular T-304 stainless steel segments, which bolt together forming a shell around the carrier pipe. T-304 stainless steel bolts and nuts shall be supplied with the spacers.
- B. The spacers shall be designed with risers (when needed) and runners to support and center the carrier pipe within the casing pipe and maintain a clearance of 1/2-inch to 1-inch maximum between the casing pipe inside diameter (ID) and the spacer outside diameter (OD).
- E. The band shall be manufactured of 8-inch (SSI-8) or 12-inch (SSI-12-2) wide, 14-gauge T-304 stainless steel. The risers shall be constructed of T-304 stainless steel having a minimum length of 6-inches (SSI-8) or 10-inches (SSI-12-2).
- F. Abrasion-resistant runners, having a minimum length of 7-inches (SSI-8) or 11-inches (SSI-12-2), and a minimum width of 2-inches, shall be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material shall be of glass reinforced plastic with the following minimum properties:
  - 1. compression strength of 25,000-psi,
  - 2. flexural strength of 32,000-psi, and
  - 3. tensile strength of 22,000-psi.
- G. The ends of all runners shall be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.
- H. On carrier pipes with an OD of 16-inches or less, each spacer shall have four riser/runner combinations-two on each half. On carrier pipes with an OD of 20-inches and greater, the number of riser/runner combinations shall be as recommended by the Manufacturer, with four being the minimum.
- I. Interior surfaces of the stainless steel shell shall be lined with EPDM having a minimum thickness of 0.090-inches with a hardness of durometer "A" 85-90. Placement of the spacers shall be a maximum of 1-foot on each side of the bell joint and one every 6 to 8-feet thereafter.
- J. Casing spacers shall be Model SSI-8 for carrier pipes 24-inches in diameter and smaller and Model SSI-12-2 for carrier pipes 30-inches in diameter and greater as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

## 2.29 CASING END SEALS

- A. Full conical-shaped wraparound seals made of 1/8-inch-thick neoprene rubber shall be provided for each end of the casing pipe. T-304 stainless steel banding straps with a 100-percent nonmagnetic worm gear mechanism and pressure sensitive butyl mastic strips shall be provided to seal edges.
- B. End seals shall be Model AW Wraparound casing end seals as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

2.30 TEMPORARY SANITARY SEWER MAIN BYPASS PIPE

- A. Temporary sewer/sewer main bypass pipe and fittings shall be High Density Polyethylene (HDPE) Pipe, unless otherwise prebid BMU Engineer approved, and shall adhere to the following:
  - 1. HDPE piping shall conform to the latest revision of the AWWA C906 standard.
  - 2. Pipe ends shall be fused together utilizing Thermal Butt Fusion or Electrofusion.
  - 3. PVC Gravity Sanitary Sewer Pipe conforming to these specifications may be used for bypass pumping on short distance low flow sewage projects if prebid BMU Engineer approved.

## **PART 3.0 - EXECUTION**

### **3.1 OWNER OPERATE**

- A. No pumps, valves, or other appurtenances of the existing sanitary sewer collection shall be operated for any purpose by the Contractor. BMU staff shall be the only authorized operator of existing collection system.

### **3.2 INTERRUPTION OF SERVICE**

- A. The Contractor shall coordinate with BMU staff of any interruption of sanitary sewer service at least 24-hours before the interruption of service. BMU Staff shall notify all customers affected by any the interruption of service.
- B. BMU is providing a courtesy to the Contractor by notifying the customers of a schedule interruption of service. It is the Contractor sole responsibility to develop, communicate and adhere to the schedule that is communicated to the BMU staff. Under no condition does BMU contacting and communicating directly with the customers relieve the Contractor of the requirements of the General Conditions of any other requirements identified in the Contract Documents.
- C. Customers shall be verbally notified and provided an interruption of service notice. In the event a consumer cannot be notified, the Contractor may need to reschedule their work until the customers are notified.
- D. The Contractor shall communicate the temporary operation of permanent lift station pumps, plugging of manholes and/or any other action that disrupts service to existing customers, directly with BMU staff.

### **3.3 ALIGNMENT AND GRADE**

- A. The Engineer of Record shall furnish all the necessary line and grade stakes, benchmarks, or other necessary control.
- B. It is the responsibility of the Contractor to protect these stakes, and any replacement of stakes shall be at the expense of the Contractor.
- C. The Contractor shall carry alignment and grade into the trench by means of an approved laser beam system and by a surveying level instrument. At no time shall the Contractor change the grade without Engineer of Record approval.
- D. If underground interference is encountered at the assigned grade, the Contractor shall notify the Engineer of Record and wait until the revised grade for the sanitary sewer system has been determined, if necessary. As a secondary check to the laser beam device, the Contractor shall check the grade from the grade stake to pipe invert a minimum of every 100-feet using a surveying level instrument.

### **3.4 SEWER PIPE MATERIAL HANDLING & STORAGE**

- A. All pipe, fittings, manholes and accessories shall be loaded and unloaded by a means to prevent shock or damage. Under no circumstances shall such material be dropped.

- B. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Piping shall not be stacked higher than Manufacturers' recommendations according to size. The bottom tier of piping shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; plain end, bell. At least two rows of timbers shall be placed between tiers, and chocks shall be affixed to each timber in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.
- D. Gaskets for push-on joints shall be stored in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

### 3.5 MATERIAL INSPECTION

- A. All pipe and appurtenances are subject to inspection by the Engineer of Record and/or BMU staff. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.
- B. Prior to being lowered into the trench, each pipe shall be carefully inspected by the Contractor and those not meeting the specified requirements shall be removed from the site immediately. Rejections may be made for any of the reasons as stated in the specifications for each specific type of pipe. Pipe having minor flaws not serious enough to cause rejection shall be installed so as to bring such flaws in the top half of the sanitary sewer. Pipe shall be protected during handling against impact, shocks, and free fall.
- C. The Engineer of Record and/or BMU staff may perform tests as specified in the applicable AWWA standard to ensure conformance with the standard. In case of failure of the pipe or appurtenance to comply with such specifications, responsibility for replacement of the defective materials becomes that of the Contractor or Manufacturer, even if piping and appurtenance has already been installed.
- D. The Engineer of Record and/or BMU staff may require a test of specimens not to exceed 5-percent of the quantity of pipe to be furnished in order to prove the acceptability of the pipe. The Manufacturer shall provide an approved testing stand near the site of the plant.

### 3.6 BMU ACCESS TO PROJECT SITE

- A. The BMU Engineer or Engineers' Representative shall have access to all parts of the job at all times. The Contractor shall furnish personnel, facilities, equipment, tools, and materials as are necessary to make whatever tests and inspection that are required by the Contract Documents.
- B. The BMU Engineer reserves the right to inspect and/or reject any part of, or all unsatisfactory work performed by the Contractor. Rejected or unapproved work shall be promptly replaced or modified to comply with these specifications.

### 3.7 REMOVAL AND ABANDONING OF SANITARY SEWER PIPE AND MANHOLES

- A. Sanitary sewer main and sanitary sewer manholes shall be removed at the locations shown on the plans or as directed by the BMU Engineer. Sanitary sewer manholes shall be entirely removed and disposed of unless otherwise directed by the BMU Engineer.
- B. Sanitary sewer pipe, 10-inch diameter and larger shall be abandoned in place by filling entire pipe with flowable fill, unless otherwise indicated.
- C. Sanitary sewer manholes that are to be abandoned in-place shall be abandoned by removing the top 4-feet (min) below finished grade elevation, seal off any incoming piping with flowable fill, install a 2-inch minimum diameter hole in the base section of the sanitary sewer manhole, and fill the sanitary sewer manhole with granular material as directed by the BMU Engineer.

### 3.8 TRENCH EXCAVATION

- A. All sanitary sewer systems shall be built in open cut trenches, except where conditions warrant, the Engineer may permit the use of short tunnels.
- B. The Contractor shall excavate to the proper depth and width necessary for the construction of the pipe according to the plans and specifications. The width of the trench at the top of the pipe shall be a minimum of 12-inches on each side of the pipe.
- C. Trenches shall be excavated with vertical sides from pipe flow line to a point 1-foot above top of pipe where possible.
- D. Trench excavation below pipe grade shall be backfilled with bedding material to provide a uniform and continuous bearing and support for the pipe.
- E. Wherever, in the opinion of the Engineer of Record, the bottom of the trench does not afford a reliable or suitable foundation, the trench shall be excavated to such additional depth as is required and replaced with trench stabilization material. Pipe bedding material will be required in addition to trench stabilization material where trench stabilization material is used.
- F. The Contractor will be fully responsible for constructing the sanitary sewer system on a stable base and any defects resulting from improperly preparing the pipe foundation shall be the Contractor's responsibility.

### 3.9 DEWATERING

- A. Water resulting from the dewatering operation shall be disposed of in a manner approved by the Engineer of Record and South Dakota Department of Environment and Natural Resources (SD DENR). It shall not be pumped onto private property without the property Owner's approval. Any damage to property, either public or private, shall be rectified to the satisfaction of the Owner and the BMU. All applicable permits must be obtained by the Contractor before the dewatering operation begins.
- B. Unless otherwise designated on project plans, it is the Contractor's responsibility to investigate soil conditions and/or review included geotechnical reports to determine what dewatering methods shall be required.

- C. Sanitary sewer main installation shall be constructed in a relatively dry trench. Joints shall not be connected under water. If ground water is encountered, the Contractor shall dewater the trench with suitable pumps and equipment. Lowering of the groundwater level shall be by means of wells, well points, or other suitable means.
- D. The water discharged from the dewatering operations shall not be allowed to wash through any excavated material. The Contractor shall be responsible for any damages that might result from this operation.

### 3.10 SEWER PIPE INSTALLATION

- A. Installation of PVC pipe shall conform to the latest revision of ASTM D2321 "STANDARD RECOMMENDED PRACTICE FOR UNDERGROUND INSTALLATION OF FLEXIBLE THERMOPLASTIC SEWER PIPE," and the Specifications and Standard Plates of the City of Brookings.
- B. Sanitary sewer main shall be installed in the locations shown on the plans or as directed by the Engineer. Before installing the sanitary sewer main, it shall be cleaned of all foreign matter and kept clean thereafter. Open ends shall be protected at all times to prevent the entrance of dirt, trench water, animals, or foreign matter into the pipe. The bell and spigot shall be wiped clean and sufficient lubrication placed on the gasket and spigot before the pipe is pushed fully into the bell.
- C. Sanitary sewer main pipe which is stubbed for future extension shall end with a bell end with a short pipe with cap installed in the bell end which can be removed for future pipe extension.
- D. Every pipe shall be bedded uniformly throughout its length with sanitary sewer main bedding material. Care shall be taken to not have any part of the pipe bearing on rocks or stones.
- E. Sanitary sewer pipe shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe.
- F. Pipe shall be carefully installed to line and grade in accordance with line and grade stakes set by the Engineer so that the finished sanitary sewer system will present a uniform bore. Any noticeable variations from true alignment or grade will be cause for rejection of the work.
- G. Pipe shall be installed up-grade with spigot ends pointing in the direction of flow.
- H. The bottom of the trench shall be freed of all rocks and stones and shall be hand shaped and bedded with bedding material as hereafter specified, and the pipe shall be in firm contact with the bedding material for its entire length. At each joint of bell and spigot pipe, a hole shall be dug of sufficient size so that the weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. Pipe must be properly fitted together.
- I. A suitable stopper shall be kept in the end of the pipe so as to prevent any dirt or water from entering during the progress of the work at all times. Any dirt, loose material, or cement mortar which may accumulate in the pipe shall be removed as the work progresses.

- J. Standard length pipe shall be utilized for all installations. Shorter lengths will only be allowed for use at sanitary sewer manhole terminations or sanitary sewer service wye locations. A full standard length pipe shall be used upstream of all sanitary sewer manholes.

### 3.11 SANITARY SEWER PIPE JOINTS

- A. All PVC Sanitary Sewer Pipe shall be jointed utilizing elastomeric gaskets as referenced in ASTM D3034 and ASTM F679 and meeting the requirements of ASTM D3212.
- B. All pipe, fittings, and joints shall be installed in full compliance with the recommended practices of the pipe Manufacturer and as specified in the latest revision of ASTM D2321.
- C. The joint surfaces (external and internal) shall be wiped free of all foreign materials, and the spigot end shall be centered on grade into the bell end and the joint shall be properly seated in accordance with the Manufacturer's recommendations.
- D. Any pipe that is field cut shall have a square end with beveled edge equal to a factory cut and all field repairs shall be performed per Manufacturer's recommendations.

### 3.12 TRACER WIRE SYSTEM FOR SANITARY SEWER FORCE MAINS

- A. Tracer wire system, including terminal boxes, ground rods and all appurtenances, shall be installed with PVC sanitary sewer force main and shall be considered incidental to the sanitary sewer force main installation. The wire shall be installed along the lower quadrant of the pipe, but the pipe shall not be laid directly on the wire.
- B. Ground rods shall be installed adjacent to connections and at locations specified on the plans. The tracer wire shall be brought to each terminal box and connected to a 60-inch ground rod. Terminal boxes shall be placed at locations designated by the Engineer and no more than 1,000-feet apart from one another or as specified on the plan notes or drawings.
- C. All underground splices shall be inspected by the Engineer of Record and/or BMU representative prior to backfilling.
- D. Prior to the road surfacing be placed, BMU shall be responsible for testing and verifying that the tracer wire has been installed and operates correctly. If the tracer wire system does not function as intended, the Contractor shall repair the system to the satisfaction of the Engineer of Record or BMU representative. Any costs associated with making the repairs to the tracer wire shall be at the Contractor's expense.

### 3.13 SANITARY SEWER MANHOLES

- A. All sanitary sewer manholes shall be constructed to meet the requirements of the latest revision of ASTM C478, "PRECAST REINFORCED CONCRETE SANITARY SEWER MANHOLE SECTIONS," and all related ASTM Specifications. Engineer of Record shall determine if manhole liners are required and indicate on Bid Form.

- B. All sanitary sewer manholes are to be built to the dimensions shown in the plan sheets, special information, detail plates, or cut sheets furnished by the Engineer of Record. All sanitary sewer manhole sections shall be numbered and/or measured by the Contractor prior to installation to assure that the finished sanitary sewer manhole will be installed to grade as specified on the plan sheet or grade sheet.

C. Base and Sections

1. Where precast concrete sections are used, the base section shall be cast with proper cutouts to accommodate the required sanitary sewer pipes. Precast sections shall be connected together using a specified gasket material and shall be in place on all sanitary sewer manhole joints to assure watertight joints. All lift holes on the interior and exterior of the sanitary sewer manhole sections shall be filled with non-shrink grout. Where installation of lift-hole plugs are required, they shall be installed into the center of the sanitary sewer manhole wall. The area on either side of the lift-hole plug shall be filled with non-shrink grout.
2. All sanitary sewer manholes shall be constructed of precast base, barrel, and cone sections. The joints between sections shall be of watertight construction utilizing a specified gasket material.
3. All sanitary sewer manholes that are constructed shall be built with the base and bottom barrel section being precast together in one integral concrete pour to form a monolithic base section. Such will provide for no joint between the base and barrel section ensuring a watertight seal. This section shall be constructed to meet the Specifications of the latest revision of ASTM C478 and the sanitary sewer manhole details in the Standard Plates.
4. Sanitary sewer manholes shall not be constructed at the Manufacturer or in the field with piping installed in the sanitary sewer manhole boots prior to setting the sanitary sewer manhole in the trench. This type of installation will be cause for rejection of the work.
5. Doghouse base section is typically not allowed, unless the BMU Engineer determines there is no other feasible method of installation. If allowed, the Contractor shall submit detailed drawings and specifications including, but not limited to, waterstop pipe connectors, non-shrink grout compounds, etc. for review and prebid BMU Engineer approval.

D. Bench and Invert

1. All inverts shall be formed to the diameter of the incoming and outgoing pipe diameter up to the pipe centerline and vertical beyond that point. The invert shall be formed to a depth of one-half to two-thirds the pipe diameter. The forming of the bench and invert shall allow for the BMU sanitary sewer television camera to be installed into the invert and into any pipe connection into the sanitary sewer manhole. Where lateral connections are required into the sanitary sewer manhole, a gradual change in the direction of the sanitary sewer manhole invert for each lateral shall be formed. Sharp angles without gradual changes in direction will not be allowed. Flat bottomed sanitary sewer manholes will not be allowed. Such work will be cause for rejection of the work.

2. Where hand formed and reconstructed sanitary sewer manhole bench and inverts are determined necessary by the Engineer, they shall be constructed with concrete. The sanitary sewer manhole invert shall be shaped and finished in a glass smooth-like finish (a steel trowel will give this finish). The bench shall have a broomed finish.

E. Adjustment Rings

1. The preferred adjustment ring height shall be 4-inches, with a 12-inch maximum of adjustment on each sanitary sewer manhole. Unless otherwise specified, the sanitary sewer manhole cover shall be set approximately 6-inches below the finished street elevation by the sanitary sewer Contractor to be raised to finished grade elevation by the Contractor prior to paving.
2. The HDPE adjustment rings shall be installed as recommended by the Manufacturer. No shims or other leveling devices, other than leveling rings provided by the Manufacturer, will be permitted with use of the HDPE adjusting rings. The annular space between the adjusting rings shall be sealed using an approved butyl rubber sealant.

F. Sanitary Sewer Manhole External Frame Seal

1. Sanitary sewer manhole external frame seals shall be used on all manholes. The sanitary sewer manhole external frame seal shall extend onto the casting and the cone section a minimum of 2-inches. Sanitary sewer manhole external frame seals shall be installed in accordance with the Manufacturer's recommendations.

G. Frame and Cover

1. Sanitary sewer manhole frame and covers shall be installed in accordance with the Standard Plates or as specified.
2. Sanitary sewer manhole frames installed onto HDPE adjusting rings shall be installed using the Manufacturer's recommended sealant between the frames and adjusting rings to form a watertight seal.
3. Sanitary sewer manhole frames offset by more than 2-inches from the adjusting rings or corbel section will be rejected.
4. Sanitary sewer manhole frames and covers shall be set to the grade specified on the grade sheet and plans. Refer to the Standard Plates for setting the frame and covers to grade, either by the circular cutout method or setting the frame and lid to grade (including side slope) prior to any asphalt lifts.
5. Sanitary sewer manhole frame and covers in permanent gravel surfaced streets shall be vertically installed so that the sanitary sewer manhole rim is set 12 to 18-inches below the finished street grade.
6. Sanitary sewer manhole frame and covers placed on the sanitary sewer manhole riser prior to final surfacing shall be bolted to the corbel section with a continuous band of butyl rubber rope gasket between the frame and the corbel section.

H. Sanitary Sewer Manhole Boots

1. The precast base section shall also contain watertight gaskets, adaptors, or sealers to ensure a leak-proof connection between the sanitary sewer manhole and the sanitary sewer pipes entering the sanitary sewer manhole.
2. Connections shall be flexible and/or pliable enough to allow for deflection from shifting or settling of the sanitary sewer manholes and to accommodate the pipe on grade. The connections shall also be capable of adapting to the various sizes and types of sanitary sewer pipe that may be used.
3. When futures are specified, a short pipe length with a cap shall be installed and sealed. This section of pipe will need to be removed and replaced when the pipe is extended from the sanitary sewer manhole.

I. Drop Sanitary Sewer Manholes

1. Drop sanitary sewer manholes shall be constructed in accordance with the Manufacturer's recommendations and as shown on the Standard Plates. The drop bowl shall be fastened securely to the wall of the manhole with stainless steel fasteners.
2. The sanitary sewer main inlet shall protrude through the sanitary sewer manhole to the edge of the drop in the bowl, where the Contractor shall make a 1 1/4-inch long 60-90 degree v-notch in the bottom of the sanitary sewer main inlet to provide improved flow control.
3. The PVC drop section shall be secured to the barrel section with stainless steel adjustable clamping. Clamps shall be required 6-inches maximum from the bottom 45 degree solvent weld elbow and 6-inches maximum from the drop bowl, with 4-foot" maximum spacing between clamps. A 45-degree bend shall be installed on the bottom of the drop to direct the flow towards the channel.
4. The stainless steel fasteners shall not be allowed to penetrate the precast sanitary sewer manhole section.

3.14 SANITARY SEWER MANHOLE LINERS

- A. The work shall include furnishing all labor, materials, equipment, and incidentals required to install sanitary sewer manhole sheet liner with studded backside in concrete sanitary sewer manholes, concrete structures, and appurtenances to effectively protect the exposed concrete surfaces from corrosion in those areas shown on the drawings or specified. The liner shall be continuous and free of pinholes at the joints and in the liner itself.
- B. All work for and in connection with the installation of the lining, field seaming, and welding of joints shall be done in strict conformity with all applicable instructions and recommendations of the liner Manufacturer unless otherwise specified.
- C. Installation of the lining and the welding of all joints shall be done in strict accordance with the Manufacturer's instructions and recommendations and the details and methods indicated on approved shop drawings by an experienced and qualified installer acceptable to the Manufacturer and the Engineer. Lining welders shall be trained and certified by the lining Manufacturer prior to the start of welding. All pipe joints and other lined areas where welding is performed shall be numbered and initialed by the welder. The Contractor shall record on a daily basis at the end

of each working day the identification of the joint areas and the welder who performed the work.

- D. Coverage of the lining shall not be less than the minimum specified or as shown on the plans. Sanitary sewer manholes and concrete structures shall be fully lined on the interior, including man-way openings, unless otherwise shown or specified.
- E. When needed, the lining shall be held snugly in place against inner forms by means of steel banding straps or other means recommended by the Manufacturer. Banding straps must be located in the interstitial space between studs to prevent crushing or tilting of the embedment studs.
- F. If liner is extended for the purpose of joint overlap, embedment studs shall terminate not more than 1/2-inch from the end of the inside surface of the pipe section. Joint flaps shall extend approximately 4-inches beyond the end of the inside surface.
- G. Concrete poured against lining shall be vibrated in a careful manner so as to protect the lining and produce a dense, homogeneous concrete, securely anchoring the locking studs into the concrete.
- H. Forms shall be properly cleaned and prepared to remove any abrasive areas that may damage the liner when removing forms. In removing forms, care should be taken to protect the lining from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the lining shall be pulled, without tearing the lining, and the resulting holes clearly marked. Form tie holes shall be marked before ties are broken off and all areas of abrasion or damage shall be marked.
- I. Hot joint compounds, such as coal tar, shall not be poured or applied to the lining. Solvents or adhesives shall not be used in fusion of material in any manner.
- J. The Contractor shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work area and shall immediately repair any damage.
- K. All welding shall be performed in accordance with the published directives and procedures of the Manufacturer and by welders certified by the Manufacturer. Completion of welding shall provide a one-piece monolithic concrete protective liner system that will provide excellent resistance to hydrogen sulfide attack and will not pull off the wall in the event that infiltration occurs.
- L. Liner Submittals
  - 1. Submit to the Engineer of Record for review, as provided in the General Conditions, complete shop drawings showing liner materials and typical installation details of all liner work and details of materials of construction and installation. The shop drawings shall include Manufacturer's detailed drawings, directions, and specifications for construction and all special and typical installations.
  - 2. Included with shipment of liner, submit certified test reports that the liner and material were manufactured in accordance with standards specified herein.
- M. Joints in Lining for Concrete Structures

1. No lining of joints shall be made until after the trench has been backfilled and the joints pressure tested. Lining at joints shall be free of all mortar and other foreign material and shall be clean and dry before joint are made.
2. Field joints in the lining shall be of the following types used as prescribed:
  - a. The joint shall be made with a separate 4-inch wide joint strip and two welding strips. The 4-inch joint strip shall be centered over the joint, and then extrusion welded to the liner. The width of the space between adjacent sheets shall not exceed 1-inch. The 4-inch joint strip shall lap over each sheet a minimum of 1.5-inch. It may be used at any transverse or longitudinal joint.
  - b. The joint shall be made by lapping sheets not less than 1-inch. The upstream sheet shall overlap the one downstream. The lap shall be tack-welded into place, and then welded with an extrusion bead over the adjoined materials.
  - c. Butt-type welds will not be allowed for field welding of joints.
3. All welding is to be in strict conformance with the instruction of the liner Manufacturer. Welding shall fuse both sheets together to provide a continuous joint equal in corrosion resistance and permeability to the liner plate.

#### N. Installation

1. Field seaming involves bonding of adjacent panels using approved thermal methods such as extrusion welding. Testing and verification of the resulting welds will be required.
2. Trial Seams
  - a. Prior to any field welding of lined surface, trial seams shall be performed to ensure that the technician and method is adequate. Trial seams shall be performed on materials from the current project, a minimum of 3-feet in length. Trial weld seams shall then be tested to ensure equipment settings are sufficient to produce quality welds. Testing shall consist of both nondestructive and destructive methods.
  - b. Non-Destructive Seam Testing
    - Nondestructive testing shall consist of spark testing. Spark testing of the finished seams is required; a copper wire may be set into the weld joint prior to welding. This will allow for spark testing for the welded seam for determination of the presence of possible leaks in the weld. This process is not necessary but may provide an alternative method for nondestructive testing of the welds. Spark testing can be performed with approved instrumentation when set at approximately 20,000 to 35,000 volts depending upon apparatus. Any defects found should be marked and repaired according to approved repair methods.
    - Repairs of pinholes and defective areas shall be performed by extruding a bead of molten plastic over the surface, or if too large, a patch shall be utilized. Once complete, retest using the spark tester when applicable.

- c. When job requirements mandate destructive seam testing of trial seams, an appropriate number of samples should be determined by the Engineer. Weld seams should then be tested for shear strength according to standard industry guidelines. When proper welding techniques are followed, the weld shall exhibit approximately 80-percent of the parent tensile yield strength in shear when tested in accordance to ASTM D 4437.

3. Field Seams

a. Non-Destructive Seam Testing

- Nondestructive testing shall consist of spark testing. Spark testing allows for the welded seam to be tested for determination of the presence of possible leaks in the weld. Spark testing may be performed over the entire surface of the weld and liner sheet. Spark testing shall be performed with approved instrumentation set at approximately 20,000 to 35,000 volts depending upon apparatus. Any defects found shall be marked and repaired according to approved repair methods. The spark testing device shall be equipped with an audible alarm indicator for signaling any defects.
- Repairs of pinholes and defective areas shall be performed by extruding a bead of molten plastic over the surface, or if too large, a patch shall be utilized. Once complete, retest using the spark tester when applicable.

3.15 SANITARY SEWER MANHOLE VERTICAL ADJUSTMENT RECONSTRUCTION

- A. Any sanitary sewer manhole that cannot be adjusted within the 12-inch height limit for adjusting sanitary sewer manholes shall be reconstructed.
- B. When an existing sanitary sewer manhole is lower than the proposed finished grade elevation, the sanitary sewer manhole shall be required to be reconstructed by:
  - 1. Removal of the cone section and adding the appropriate height of barrel section(s) to increase the sanitary sewer manhole height to a level that the sanitary sewer manhole can be adjusted using the appropriate height of adjusting rings.
- C. When an existing sanitary sewer manhole is higher than the proposed finished grade elevation, the sanitary sewer manhole shall be required to be reconstructed by:
  - 1. Removal of the cone and barrel section(s) and installing the appropriate height of barrel section to decrease the sanitary sewer manhole height to a level that the sanitary sewer manhole can be adjusted using the appropriate height of adjusting rings.

3.16 MANHOLE CONSTRUCTION PLATE MARKER

- A. The sanitary sewer manhole construction plate markers shall be used on all BMU, City of Brookings projects or development projects.

- B. Sanitary sewer manhole construction plate markers shall be installed on existing sanitary sewer manholes immediately after construction surfacing removals have been completed and on new sanitary sewer manholes immediately after installation.
- C. The markers, on asphalt streets, shall remain on the sanitary sewer manhole until after the first lift of asphalt is installed (with exception to when any internal sanitary sewer manhole construction work may need to be performed).
- D. The markers on concrete streets shall remain on the sanitary sewer manhole until concrete paving occurs.
- E. The Contractor shall ensure that all sanitary sewer manholes are secured, protected, and watertight at the end of each work day. Under no circumstances shall an uncompleted or completed sanitary sewer manhole be left uncovered, unprotected, or not watertight overnight.

### 3.17 CONNECTIONS TO EXISTING SANITARY SEWER MANHOLES

- A. The Contractor shall cut the necessary openings into the existing sanitary sewer manholes and make the connections thereto in a neat and workmanlike manner. If the Contractor is unable to make the necessary penetration(s), BMU will make the opening and invoice the Contractor for the work completed.
- B. The connections shall be made so as to make the joints around the entering sanitary sewers watertight and an approved smooth channeled flow line shall be constructed. All existing cast-in-place, precast, and block-type sanitary sewer manholes shall be core drilled, and sanitary sewer manhole boots shall be installed for the pipe connection.
- C. Where existing sanitary sewer manholes are constructed of brick, cobblestone, or other materials determined by the BMU Engineer that cannot be core drilled, pipes shall be grouted into the sanitary sewer manhole wall with non-shrink grout and a water seal. The water seal shall be placed continuously around the pipe to form a seal. The water seal shall be a butyl rubber rope type material.
- D. All sanitary sewer manhole bench and inverts shall be reconstructed as a part of the connection to the existing sanitary sewer manhole.

### 3.18 EXTENSIONS FROM SANITARY SEWER MANHOLES

- A. Futures from sanitary sewer manholes shall be defined as piping and plugs that extend longer than one standard 13-foot section of pipe. Futures shall be plugged with a watertight plug at a bell end section of pipe.
- B. Stubs from sanitary sewer manholes shall be defined as a 5-feet or less section of pipe with a plug at the bell end or capped on a plain end section of pipe.
- C. Stubs and futures from a sanitary sewer manhole shall be installed to grade.
- D. Connecting onto stubs will not be allowed. Stubs must be removed from the existing sanitary sewer manhole when connections to the sanitary sewer manhole are installed and a full section of pipe must be installed. Stubs shall not extend more than 5-feet and no less than 3-feet in length from the sanitary sewer manhole unless otherwise specified.

### 3.19 PIPE COUPLINGS

- A. Pipe couplings are typically not allowed, but if deemed necessary by the Engineer of Record, connect two spigot ends of the same diameter pipe together if the bell and spigot connections are not possible. Reducing couplings shall not be allowed.

### 3.20 SERVICE CONNECTIONS

- A. For all new sanitary sewer mains, prefabricated wyes shall be installed for all sanitary sewer service stub-out locations and sealed with an approved watertight cap or plug. Wyes with the same branch pipe diameter as the main line sanitary sewer will not be permitted.
- B. All taps of the existing sanitary sewer main shall be made by BMU where the sanitary sewer main is clay pipe material. BMU will provide the saddle and all equipment necessary to make the tap into the clay pipe. Taps on existing clay pipe shall be made by tapping the line and using a saddle to connect the service pipe to the main line. Cutting out a section of main line pipe and installing a wye and couplings will not be permitted.
- C. All wyes or taps which are not to be immediately connected shall be closed with a watertight cap or plug. All wyes and stub-outs shall be marked with a marker to help relocate them and prevent breakage when excavating. All stub-outs shall be capped and sealed.

### 3.21 BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING

#### A. Bedding of Pipe

- 1. The trench base shall be undercut a minimum of 6-inches below the bottom of the pipe and uniformly backfilled with bedding material to 6-inches above the pipe.
- 2. Pipe shall be installed on top of the first layer of bedding material and the pipe shall be backfilled with bedding material up to the "spring-line" (halfway) on the pipe. The bedding material shall be "shovel-sliced" or hand tamped around and under the haunches of the pipe to assure adequate and uniform support along the bottom of the pipe.
- 3. Care shall be taken in placing backfill over the crown of the pipe to avoid damage to the pipe. Care shall be taken to prevent dislodging and misalignment of the pipe and to provide adequate bell hole for the pipe.
- 4. All sanitary sewer service lines shall be installed with bedding material from 2-inches below the pipe to 2-inches above the top of the pipe.

#### B. Initial Backfilling of Pipe Trench

- 1. Above the bedding area the pipe shall be backfilled with acceptable native material (Class I, II, and III as described in C605), approved by the Engineer of Record and compacted to 95-percent Standard Proctor Density to 12-inches above the top of the pipe bedding.
- 2. If unacceptable initial backfill material is not found onsite, Contractor shall furnish and install import engineered fill or clay material in the initial backfilling

area. Imported material shall be placed in a minimum of two (2) lifts and compacted to a minimum of 95-percent Standard Proctor Density to 12-inches above the top of the pipe bedding.

3. The initial backfill shall be placed evenly so as not to disturb the grade or line of the pipe.
4. Stones larger than 3 inches in diameter shall not be placed within initial backfill of the pipe trench. Care shall be taken in placing backfill over the pipe to avoid damage to the pipe.
5. Native material for all initial backfilling of the pipe trench shall be free of debris, frozen material, large clods or stone, organic matter or other unstable material. Stones larger than 3-inch in diameter shall not be placed within the initial backfill area.

C. Final Backfilling of Trench to Grade

1. All final backfill material shall consist of acceptable native excavation material, approved by the Engineer of Record, and shall be placed in maximum 12-inch lifts and compacted by suitable and approved compaction methods in a manner to achieve at least 95-percent Standard Proctor Density, or as otherwise specified.
2. If unacceptable final backfill material is encountered in the trench excavations, it shall be replaced with other suitable material available at the project site, imported engineered fill, imported clay material or with other suitable imported material, as approved by the Engineer of Record.
3. At least 12-inches of cover shall be placed over the top of the pipe before the trench is wheel-loaded, and 48-inches of cover shall be placed over the top of the pipe before the trench is hydro-hammered for compaction.
4. Material for all areas of backfilling is to be free of debris, frozen material, large clods or stone, organic matter or other unstable material.
5. In final backfill areas below pavement, the Engineer may direct the Contractor to use native material a specified distance below the pavement elevation to ensure a consistent material is utilized under the pavement section.
6. Excess material not required for final backfilling shall be removed by the Contractor or otherwise disposed of as directed by the Engineer.

D. Road Surfacing Base Material

1. Material used under concrete and asphalt surfacing shall meet the requirements as indicated in the Products section of these specifications for "AGGREGATE BASE MATERIAL".
2. Base material shall be placed in maximum 6-inch lifts and compacted by suitable and approved compaction methods in a manner to achieve at least 97-percent Standard Proctor Density, or as otherwise specified.

E. Compaction Testing Requirements

1. All bedding and backfill areas shall be subject to compaction testing by nuclear or standard methods according to the latest applicable ASTM Specifications.

2. Frequency of compaction tests shall be completed in accordance with South Dakota Department of Transportation (SDDOT) Standard Specifications for Roads and Bridges, current edition.
3. The areas requiring compaction testing shall include the bedding, initial backfill, final backfill, road surface base and gravel surfacing, as defined in the previous sections.
4. The Engineer of Record may require random compaction tests of the material. If any of these tests indicate that the material has not been compacted to the required density, the Contractor shall re-compact said material at no additional cost to the Owner, and the Engineer of Record shall then have the right to take additional compaction tests to assure that this material is compacted to the proper density without any additional cost to the Owner.

### 3.22 UNDERGROUND INTERFERENCE

- A. The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies and BMU, but this does not relieve the Contractor of the responsibility of contacting SD ONE CALL and determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables, or structures which will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the Owners of the structure involved and the Engineer of Record.
- B. When necessary, the Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.
- C. Portions of utilities which are found to interfere with the alignment and grade of the sanitary sewer main will be relocated, altered, or reconstructed by the Owners, or the Engineer may order changes in the work to avoid interference.
- D. Temporary or permanent relocation or alteration of utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where utility relocation or reconstruction is impractical, the Engineer may order a deviation from alignment and grade.
- E. Unless otherwise noted, all costs of exploratory investigation or excavations necessary for determining the location and depth of utilities shall be included in the contract bid price for installing pipe.

### 3.23 SANITARY SEWER AND WATER MAIN SEPARATION

- A. Horizontal Pipe Separation
  1. Sanitary sewer shall be laid at least 10-feet horizontally from any existing or proposed water mains. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, BMU may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the sanitary sewer closer to a water main, provided that the water main is in a separate trench or on an

undisturbed earth shelf located on one side of the sanitary sewer main with the bottom of the water main 18-inch above the top of the sanitary sewer.

**B. Vertical Pipe Separation for Water Main Crossings**

1. The vertical separation between the water main and sanitary sewer main shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the sanitary sewer main to the outside of the water main. This shall be the case where the water is either above or below the sanitary sewer with preference to the water main located above the sanitary sewer.
2. The crossing shall be constructed so that a full length water main pipe be used and the pipe joints will be equidistant and as far as possible from the water main.
3. In the event 18-inches of vertical pipe separation cannot be maintained, adhere to one of the following:
  - a. Use vertical bends to lower the water main under the sanitary sewer main.
  - b. Install an encasement pipe around the water main. The encasement pipe shall be 20-foot minimum in length, centered where the pipes intersect, and sealed at both ends with end seals.

**3.24 SANITARY SEWER AND STORM SEWER SEPARATION**

**A. Horizontal Pipe Separation**

1. Sanitary sewer shall be laid at least 10-feet horizontally from any existing or proposed storm sewer mains. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, BMU may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the sanitary sewer closer to a storm sewer main, provided reinforced concrete pipe (RCP) storm sewer pipe be assembled with either:
  - a. A gasket that conforms to ASTM C443 specifications (generally available for round RCP pipe up to 72-inches), OR:
  - b. A watertight sealant meeting ASTM C990, AASHTO M 198, and Federal Specification #SS-S-210-A.

**B. Vertical Pipe Separation for Storm Sewer Crossings**

1. The vertical separation between the sanitary sewer and storm sewer main shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the storm sewer main to the outside of the sanitary sewer. The minimum vertical separation of the sanitary sewer and the storm sewer is dependent on the size of the storm sewer pipe. Larger diameter storm sewer pipes have a greater minimum clearance to prevent sanitary sewer pipes from freezing.
2. In the event that vertical pipe separation cannot be maintained, adhere to one of the following:
  - a. Install an encasement pipe around the sanitary sewer. The encasement pipe shall be 20-foot minimum in length, centered where the pipes

intersect, and sealed at both ends with end seals AND install rigid insulation between the storm sewer and sanitary sewer.

### 3.25 SANITARY SEWER SERVICES

- A. The sanitary sewer service is the pipe that conveys raw wastewater to the public sewer from the private structure, including but not limited to residential, commercial, industrial, institutional and other such connections. All sanitary sewer service installation methods and procedures shall conform to the Local, State or National Plumbing Code.
- B. Sanitary sewer service pipe shall be bedded in accordance with the requirements of "BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING".
- C. All sanitary sewer services shall have a nominal inside diameter of not less than four (4) inches. Sanitary sewer services shall be laid at a minimum slope of 2.0% (1/4-inch per foot) to the right of way or property line.
  - 1. From the right of way line to the structure, sanitary sewer service pipe may be laid at a minimum slope as defined in the South Dakota Department of Environment and Natural Resources (SDDENR) "RECOMMENDED DESIGN CRITERIA MANUAL FOR WASTEWATER COLLECTION AND TREATMENT FACILITIES"
- D. 4-inch and 6-inch diameter sanitary sewer services shall not be directly connected to manholes.
- E. Cleanouts are required for sanitary sewer service lines greater than 75-feet in length or change in horizontal direction, and shall be used only in approved locations.
  - 1. Cleanouts shall be required to be brought to grade every 75-feet (maximum) for 4-inch sanitary sewer services and every 100-feet (maximum) for 6-inch sanitary sewer services.
  - 2. Cleanouts shall be covered at finished grade with a frame and cover.
  - 3. Cleanouts must be located within 5-feet of all commercial buildings. At least one cleanout shall be provided for all commercial buildings. The size of the cleanout piping shall be in accordance with the "SOUTH DAKOTA UTILITY CONTRACTOR HANDBOOK".
- F. Glued connections will only be allowed at the connection between the SDR 35 or SDR 26 and the Schedule 40 PVC pipe at the building.
- G. PVC service lines shall be plugged at a bell end section of pipe. If a cap is to be used, the cap shall be glued to the service stub to accommodate an air pressure test, infiltration test or exfiltration test.
- H. 22 1/2-degree bends shall not be located closer than 3-feet from each other.
- I. Couplings, on new construction, will not be allowed unless the building's sanitary sewer stub-out exists before the sanitary sewer service from the property line to the building is installed. If couplings are determined to be necessary, only one coupling for each service line will be allowed on new construction.

- J. All sanitary sewer service lines shall be installed with a marker to help locate them and prevent breakage when excavating the service.
  - 1. Sewer service shall be marked by a vertical 4-inch PVC pipe or an approved marker. The top 1-foot portion of the marker should be painted green.
  - 2. The marker should be placed near the termination point of the sanitary sewer service.
  - 3. The sanitary sewer service marker shall remain in place and be maintained by the Developer or Property Owner until the sanitary sewer service is extended into the property to serve a house, building, or other structure.
- K. Sanitary sewer service risers shall be installed when the depth is 20-feet or more from the sanitary sewer main invert to the proposed road grade.
  - 1. Elevations for an approved sanitary sewer service riser shall be determined by the Engineer of Record or Property Owner.
  - 2. The in-line wye, pipe and fittings (bends) shall be PVC SDR 26 until the sanitary sewer service is 5-foot (min) onto virgin ground. After the sanitary sewer service is installed 5-foot (min) onto virgin ground, the sanitary sewer service may revert to ASTM D3034 with a SDR 35 rating, unless otherwise specified.
  - 3. Pipe bedding material shall be required from the center of the carrier sanitary sewer main up to where the sanitary sewer service riser is anchored to the virgin soil to ensure the sanitary sewer service shall be stable when backfilling.
- L. Sanitary sewer services installed via directional boring or hole-hogging are to be installed as indicated on the project plans with prior approved by the BMU Engineer.
  - 1. 4-inch to 6-inch sanitary sewer service piping and fittings installed via directional boring or hole hogging shall conform to the latest revision of ASTM D3034, SDR 26. SDR 26 PVC pipe and fittings shall be used from one end of the directional bore or hole-hog to the other end of the directional bore or hole-hog.
  - 2. On either side of the directional bore or hole-hog the sanitary sewer service may be reverted to ASTM D3034 with a SDR 35 rating, if depth allows.
  - 3. Prior to inspection, the Contractor shall be required to clean the sanitary sewer service line which has been directional bored or hole hogged with a bean machine or etc., and get all excess debris and water out of the sanitary sewer service line.
  - 4. The Contractor, as witnessed by BMU staff, shall then pour a determined amount of water, such as five gallons, in the high end of the sanitary sewer service line with a minimum of 95% of the water being retrieved at the low end of the sanitary sewer service line for the service line to pass inspection. This is to ensure that there are no sags in the sanitary sewer service line where directional boring or hole hogging was utilized.
- M. All sanitary sewer service taps must be adequately supported prior to backfilling. The Contractor must coordinate all BMU installed sanitary sewer service taps with BMU crews.

- N. The trench for the sanitary sewer service taps shall be excavated to meet all applicable OSHA trench safety requirements prior to any work to be completed by BMU personnel. If the trench is unsafe to complete sanitary sewer tapping operations, the Contractor shall be required to provide the necessary additional work to ensure safety of the trench to the satisfaction of the BMU tapping personnel.
- O. At locations where reconnecting sanitary sewer service lines to the new sanitary sewer main, all new service lines shall be connected with a wye connection.
  - 1. A tapping tee will only be allowed where determined necessary by the BMU Engineer. A coupling will be allowed for connecting the new service line to the existing service line.
- P. Existing clay service lines that are to be abandoned shall be capped with non-shrink grout placed continuously for a 1-foot distance into the pipe.

### 3.26 ABANDON SEPTIC TANK

- A. If a sanitary sewer service is being installed to replace an existing septic tank system, the Contractor shall decommission the septic tank after installation of the sanitary sewer service.
- B. If the septic tank system is not completely removed, the Contractor shall pump out and dispose of all existing sludge in the septic tank and then remove and dispose of the top section of the concrete septic tank.
- C. The Contractor shall break up or punch holes in the floor of the remaining bottom section of the septic tank to allow the ground water through and keep the tank from floating. The Contractor shall fill the septic tank with IMPORTED ENGINEERED FILL MATERIAL.

### 3.27 BACKFLOW PREVENTER INSTALLATION

- A. Backflow preventers shall be installed on all new construction with sub-grade levels. Slab on grade buildings or basement injector pumps are exempt from this requirement. The backflow preventer shall be plumbed on the main sewer service main to protect sub-grade levels from surcharges in the public sanitary sewer collection system. Sanitary sewer flows from the at-grade and/or above-grade levels shall be plumbed to by-pass the backflow preventer.
- B. Installer shall follow backflow preventer manufacturer's installation requirements and ensure the 2% minimum slope on the sewer service line continues through the backflow preventer valve installation. All new construction shall have the backflow preventer installed within the building footprint for accessibility and maintenance purposes. An exterior located backflow preventer valve will not be allowed on new construction. The access cover for the backflow preventer shall be brought up to the sub-grade finished floor for ease of access.
- C. Installer shall install a 4.5"x4.5" (minimum size) adhesive-backed sticker indicated that a backflow preventer is installed at this location and be affixed in a visible spot near the backflow preventer installation. Sticker shall include information to let the customer know that there is backflow preventer installed in this location and that regular maintenance is required with this type of equipment.

### 3.28 CASING PIPE VIA BORING (JACKING)

- A. It shall be the responsibility of the Contractor to maintain the alignment and grade specified. The boring (jacking) specifications shall be in accordance with these specifications, plan sheets, plan notes and Standard Plates.

### 3.29 TEMPORARY SANITARY SEWER BYPASS SYSTEM

- A. The Contractor shall coordinate with all property Customers for a planned disruption of sanitary sewer service or accessibility issues created by the temporary sewer main bypass system.
- B. Contractor shall provide a 24-hour contact person who has adequate parts and equipment readily accessible to make necessary repairs to temporary sanitary sewer main bypass system in a timely manner.
- C. The Contractor shall contact all property Customers (that are at the property at the time of service interruption) along any sanitary sewer main project where the property Customers have the potential to discharge sanitary sewer into the construction area due to an open service line in the trench or other means. The Contractor shall inform the Customers not to discharge sanitary sewer during the time(s) when the Resident's sanitary sewer service is not connected to the BMU sanitary sewer system. The Contractor shall inform the Resident of the estimated time that the service will not be functional and inform them immediately (by door hanger if not home) when their service can be used.
- D. The Contractor shall also install door hangers (furnished by the BMU) on each affected property Customers door. The door hanger shall indicate the time when the property will not be allowed to discharge sewage to the sanitary sewer system and a Contractor phone number for answering questions.
- E. Sanitary Sewer Bypass System
  - 1. A minimum of 2-weeks prior to bypass pumping, the Contractor shall submit a detailed written description, with detailed drawing, of the temporary sanitary sewer bypass system for BMU Engineer approval.
    - a. The submittal shall include information on the quantity, capacity, and location of all pumping equipment. The submittal shall include pump Manufacturers' pump performance curves.
    - b. The size, type, and routing of all suction and discharge piping shall be provided. Materials, joint types, and calculated static head and friction values for flows and diameters relative to the length of discharge piping for the bypass shall be submitted.
    - c. When calculating static head, Contractor should take into account the maximum discharge pipe elevation. The Contractor shall also provide a written emergency plan.
  - 2. The BMU Engineer shall be given written notice, at least 2-days in advance, of intent to commence sanitary sewer bypass pumping operations.
  - 3. Bypass piping required for an extended period of time, if directed, shall be buried or covered by granular material ramps where the pipe crosses bike trails, sidewalks, driveways, roads, pedestrian crossings, entrances, etc.

4. When bypass pumping is in operation, bypass system shall be monitored continuously by personnel familiar with the bypass pumping system operation and maintenance, and has in possession the BMU Engineer approved written emergency plan. Contractor shall provide the necessary labor, equipment and fuel to ensure uninterrupted and sufficient pumping at all times. Bypass pumping will be required for the duration of the project until the new sewer main has passed all required tests and is capable of conveying the wastewater flows.
5. Where existing flow cannot be maintained, interruption of service shall be minimized such that no discharge of sanitary sewage to any natural waterway, storm sewer, open trench, trench excavation, ground surface, street, gutter or any other place which may constitute a health hazard.
6. The Contractor is hereby notified that the temporary bypass system is critical to the Owners' overall operation. The Contractor shall provide adequate supervision, fuel, labor and materials to ensure continuous operation of the temporary sanitary sewer bypass system. The Contractor shall be liable for any environmental damages, sewage backups in homes or fines caused by the failure to maintain continuous operation of the temporary bypass system.
7. Bypass operations must be approved by the Owner and/or BMU Engineer before starting. Bypass pumping equipment shall include pumps, piping, and related equipment necessary to divert the flow of sewage around the section in which the work is to be performed. In addition, the Contractor shall maintain at the same location and in operable condition, duplicate equipment to be used in case there is equipment failure. In this event, the Contractor shall promptly repair or replace the failed equipment to the satisfaction of the BMU Engineer. The new sewer line may be used by the Contractor to carry the sanitary flows after the new pipe has passed inspection and required testing. Any "temporary" connections to the new sewer main are subject to BMU Engineer approval.
8. All pumps and piping systems shall have sufficient capacity to accommodate the peak flow of the sanitary sewer main being bypassed. The temporary bypass shall consist of no less than 2-pumps at each pumping location and each must be capable of conveying the peak flow with any single pump out of service. The pumps shall be provided with suction piping and plumbed as required. Only specified sanitary sewer manholes may be used for sewage access. To achieve favorable pumping conditions and to prevent suction lines from impacting the flow in the interceptor, temporary sumps shall be installed at the Contractor's desired pumping locations as per the BMU Engineer approved Contractor's detailed drawing. The sump is to be installed adjacent to BMU Engineer approved sanitary sewer manholes and in accordance with the temporary bypass Supplier's requirements. The pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range without surging, cavitation's, or vibration. The pump shall not overload the driver at any point on the pump-operating curve. The pump shall be suitable for use with raw unscreened sewage and trash.
9. The pump shall be a self-contained unit designed for temporary use. All pumps shall be equipped with prime assist features to ensure re-prime. Pumps shall be capable of re-prime lift of up to 15-feet. The pumps must be constructed to allow dry running for long periods of time to accommodate the cyclical nature

of wastewater flows. The Contractor shall provide the necessary start/stop controls for each pump.

10. See Standard Plates for bypass pump and piping arrangement requirements. Provide pressure gauges on the suction and discharge side of all pumps. The Contractor shall provide a flow meter at the discharge of each pump used for the bypass for mains 24-inches and larger. Provide LCD displays capable of showing instantaneous, peak, daily and monthly flows with an accuracy of +/- 5%. Provide mechanical indicators on all check valves. Field demonstrate two points on the pump curve for each pump to verify capacity. The bypass pumping system shall be in operation a predetermined time prior to any existing piping may be removed. At the bypass location, pumps, motors, engines, suction sanitary sewer manholes and generators shall be surrounded by a safety fence.
  11. Sanitary sewer manholes and/or sumps opened for use as suction or discharge points must be kept sealed to prevent odors from escaping.
- F. Contractor shall comply with City sound ordinance and obtain a noise permit if pumping is required between the hours of 10:00 PM and 7:00 AM. Each pump setup shall meet the following noise requirement as measured on the dBA scale at the measured distance from the suction point: 85 dBA at 23 feet.
  - G. Temporary electric power for the temporary sanitary sewer bypass system pumps may be available at a cost to the Contractor. Contact Brookings Municipal Utilities for temporary electric power availability and cost estimates.
  - H. The sanitary sewer bypass system shall be hydrotested at 50-psi prior to commencing bypass pumping. The system shall hold the pressure for a minimum of 1-hour without dropping more than 5-psi. If pressure drops more than 5-psi, the Contractor must drain the line and retest after repairs have been made. Water for hydrotesting may be drawn from a BMU fire hydrant, which shall be operated only by BMU Personnel. The Contractor will not be charged for water usage for hydrotesting. Discharge shall go into the BMU sanitary sewer system.
  - I. The Contractor shall provide adequate fittings for the discharge piping to accommodate flushing after use. Discharge pipes shall be flushed after each use before they can be moved. Water for flushing the bypass lines may be drawn from a BMU fire hydrant, which shall be operated only by BMU Personnel. The Contractor will not be charged for water usage for flushing the discharge pipes. Discharge shall go into the BMU sanitary sewer system.
  - J. The temporary sanitary sewer bypass pumping system supplier shall be prebid BMU Engineer approved:

### 3.30 SURFACE RESTORATION

- A. The Contractor shall replace all surface material and shall restore paving, curb and gutter, sidewalks, lawn irrigation, fences, trees, sod, topsoil, and other items disturbed to a condition equal to or better before the work began; furnishing all labor, materials, and equipment necessary to do this work. Surface restoration shall conform to all City or DOT right-of-way requirements.

### 3.31 CLEANING AND CCTV INSPECTION

- A. After each section of sanitary sewer between sanitary sewer manholes has been completely installed and backfilled, the line and sanitary sewer manholes shall be inspected by the Contractor for leakage. All visual leakage at individual joints or other parts of the sewer and/or leakage in excess of that specified shall be repaired by the Contractor at the Contractor's expense before the sewer is accepted.
  - 1. The repair of leaks may require the removal and replacement of sanitary sewer manhole sections and pipe sections.
  - 2. The use of grout to repair leaks will not be allowed.
  - 3. The actual method of correction shall be approved by the BMU Engineer prior to performing the repair.
- B. The Contractor shall be responsible for all work necessary to make the sewer acceptable for usage including removal of all mud, silt, rocks, or blockages that might hinder the flow and make said sewer and manholes unacceptable for final acceptance and usage.
  - 1. BMU will not be responsible for cleaning mains prior to televising the sewer.
  - 2. In the event that the line is not acceptable for televising, due to the Contractor's operations, the Contractor will be notified. It will be the Contractor's responsibility to make arrangements to clean the sewer and make it acceptable for the television work.
- C. BMU will perform an inspection of the completed sewer line through the use of a closed circuit television camera. The expense of the initial television inspection and one additional re-inspection will be borne entirely by BMU.
  - 1. If defective workmanship of material or construction is noted, the deficiency shall be corrected by the Contractor at no expense to the Owner.
  - 2. BMU will perform additional television inspections to review if the repairs were made properly and in accordance with the specifications. The expense of any additional television inspections beyond the initial inspection and one additional re-inspection will be borne entirely by the Contractor.
  - 3. The Contractor shall be responsible for all related costs, including concrete or asphalt resurfacing, if the street has been surfaced. The Contractor shall be required to repair all areas of infiltration and other deficiencies.

### 3.32 DEFLECTION TEST

- A. Deflection tests shall be performed by the Contractor on all PVC sanitary sewer mains.
  - 1. The Contractor shall provide and pull a BMU approved deflection gauge (mandrel) device through the sanitary sewer main after the sanitary sewer main backfilling has been completed.
  - 2. The diameter of the deflection gauge device shall be 95-percent of the undeflected inside diameter of the flexible pipe. The Contractor shall be required to install the pipe in such a manner so that the diametric deflection of the pipe shall not exceed 5-percent.

3. All pipes exceeding the 5-percent deflection within the initial deflection test and within the corrective period (warranty period) shall be re-laid or replaced by the Contractor at no additional cost to the Owner.
4. The Contractor shall be responsible for all restoration costs, including all streets, alleys, boulevards, etc.

### 3.33 SEWER PIPE INFILTRATION/EXFILTRATION TEST

- A. Sanitary sewer piping shall be tested using one of two methods, infiltration test or pipe exfiltration test (low pressure air test).
  1. The pipe infiltration test shall be used when the ground water table elevation is greater than 2-feet above the top of the pipe as determined by the Engineer of Record.
  2. The pipe exfiltration test (water test or low pressure air test) shall be used when the ground water table elevation is less than 2-feet above the top of the pipe as determined by the Engineer of Record. Exfiltration testing of the pipe with water will only be allowed where specifically specified.
- B. When existing sanitary sewers which have service connections are being reconstructed or replaced (example: street reconstruction projects), the leakage test requirements may be waived or other testing methods substituted, subject to the approval of the BMU Engineer.
- C. Repair of leaks may require the removal and replacement of pipe sections. The use of grout to repair leaks will not be allowed.
- D. The Contractor shall notify the BMU Engineer 24-hours prior to performing the test to enable the Engineer and/or representatives to be present during the testing operations. All data will be recorded and evaluated by the Engineer. All lined sanitary sewer manholes and pipe shall be tested prior to welding the joints.
- E. Infiltration Test
  1. This test shall be performed by the Contractor using a V-notched weir in the downstream sanitary sewer manhole of a line segment to measure the upstream sewer leakage. The test shall be maintained for not less than 24-hours before the measurement is performed. The test shall be performed one line segment at a time (a line segment shall be defined as the line from one sanitary sewer manhole to the next adjacent sanitary sewer manhole). The V-notched weir shall have volumetric calibrations (gallons/24 hours) and shall be easy to read.
  2. The Engineer may waive the use of the V-notched weir if the Engineer determines that the leakage flow is obvious or nonexistent through visual inspection. The maximum allowable infiltration or exfiltration for any new sanitary sewer section, including all sanitary sewer manholes, shall be 50-gallons per inch of diameter per mile of pipe per day. All visible leakage at individual locations (including the amounts less than the 50-gallons per inch of diameter per mile of pipe per day) as determined by the Engineer shall still be the Contractors responsibility to repair. Payment for the infiltration test will be incidental to the pipe and sanitary sewer manhole installation.
- F. Pipe Exfiltration (Water) Test

1. The low pressure air test shall be used for the exfiltration test unless otherwise specified. The pipe exfiltration (water) test shall only be allowed where specified.
2. The pipe exfiltration (water) test shall be performed by sectionalizing the test so that interior pressure in pipe does not exceed 5-feet of water pressure. The test will be performed by the Contractor as follows:
  - a. Clean the section of sewer line to be tested by flushing or other means prior to conducting the low-pressure air test. This cleaning serves to eliminate debris and produce the most consistent results.
  - b. Place watertight bulkhead in inlet of the upstream and downstream sanitary sewer manholes of sewer to be tested.
  - c. Fill section of sewer and upstream sanitary sewer manhole with water until the elevation of water in the upstream sanitary sewer manhole is 2-feet higher than the top of the pipe in the line being tested or 2-feet above the existing ground water in the trench-whichever is the higher.
  - d. Allow the water to stabilize for 1/2-hour, then fill the sanitary sewer manhole with water to the original level and begin the test.
  - e. The amount of water lost in the sanitary sewer manhole during 1-hour will be measured and used to determine the exfiltration. The maximum allowable drop in vertical water height in the sanitary sewer manhole shall be 1/4-inch for all diameter sanitary sewer manholes. If the water level in the sanitary sewer manhole drops below the allowable drop amount, the Contractor shall repair the leak and retest.

G. Pipe Exfiltration (Low Pressure Air) Test

1. The pipe exfiltration (low pressure air) test shall be performed in accordance with ASTM F1417 standards. The following procedure is summarized from ASTM F1417 and shall be followed in conjunction with ASTM F1417 unless modified by the Engineer.
2. The Contractor shall adhere to the following procedure for testing the sanitary sewer pipe:
  - a. Clean the section of sewer line to be tested by flushing or other means prior to conducting the low-pressure air test. This cleaning serves to eliminate debris and produce the most consistent results.
  - b. Isolate the section of sewer line to be tested by inflatable stoppers or other suitable test plugs.
  - c. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. All plugs and caps shall be securely braced to prevent blow-out. One of the plugs or caps should have an inlet tap, or other provision for connecting a hose to a portable air control source.
  - d. Connect the air hose to the inlet tap and portable air control source. The air equipment shall consist of necessary valves and pressure gauges to control an oil-free air source and the rate at which air flows into the test section to enable monitoring of the air pressure within the test section.

- e. Add air slowly to the test section until the pressure inside the pipe reaches 4.0-psi.
- f. After the pressure of 4.0-psi is obtained, regulate the air supply so that the pressure is maintained between 3.5-psi to 4.0-psig for at least 2-minutes depending on air/ground temperature conditions. The air temperature should stabilize in equilibrium with the temperature of the pipe walls. The pressure will normally drop slightly until equilibrium is obtained; however, a minimum of 3.5-psi is required.
- g. Determine the rate of air loss by the time-pressure drop method.
- h. Time-Pressure Drop Method; Air is slowly introduced into the section of pipe to be tested, until the air pressure is raised to approximately 4.0-psi and the test pipe section is stabilized as in:
  - Disconnect the air supply and decrease the pressure to 3.5-psi before starting the test. Determine the time required for the pressure to drop from 3.5-psi to 2.5-psi, and compare this interval to the required time to decide if the rate of air loss is within the allowable.
  - Minimum holding times required by pipe diameter are shown in the Low Pressure Air Test Table and are also listed in ASTM 1417.
3. Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until all air pressure in the test section has been reduced to atmospheric pressure.
4. The Low Pressure Air Test Table below indicates the minimum test period durations, length of test section for minimum test durations, and the formula to calculate the testing time when the test section length exceeds the length for minimum test time (in accordance with ASTM F1417).
5. The Engineer may reduce the testing time to one-half the testing time if the pressure drop is less than 0.5-psi for the first one-half the test period listed in Low Pressure Air Test Table.

Table 8- Low Pressure Air Test Table

Nominal Pipe Diameter (in)	Minimum Time, (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)
4	3:46	597	0.380 * L
6	5:40	398	0.854 * L
8	7:34	298	1.520 * L
10	9:26	239	2.374 * L
12	11:20	199	3.418 * L
15	14:10	159	5.342 * L
18	17:00	133	7.692 * L
21	19:50	114	10.470 * L

<b>24</b>	22:40	99	13.674 * L
<b>27</b>	25:30	88	17.306 * L
<b>30</b>	28:20	80	21.366 * L
<b>33</b>	31:10	72	25.852 * L
<b>36</b>	34:00	66	30.768 * L
L = Length of Pipe being Tested (ft)			

### 3.34 MANHOLE INFILTRATION/EXFILTRATION TEST

- A. All sanitary sewer manholes shall be tested and inspected for leakage by the Contractor. Repair of leaks may require the removal and replacement of sanitary sewer manhole sections. The use of grout to repair leaks will not be allowed.
- B. The Contractor shall perform sanitary sewer manhole vacuum tests when the ground water table elevation is lower than 2-feet above the top of the pipe. Exfiltration testing with water will only be allowed where specifically specified.
- C. Sanitary Sewer Manhole Vacuum Test
  1. The sanitary sewer manhole vacuum test shall be performed in accordance with ASTM C1244. The following procedure is summarized from ASTM C1244 and shall be followed in conjunction with ASTM C1244 unless modified by the Engineer. The vacuum test shall include testing the top of the sanitary sewer manhole, excluding the adjusting rings and sanitary sewer manhole frame and cover. Testing will be allowed after backfilling has occurred or as specified in the specifications. Sanitary sewer manhole vacuum tester assembly and vacuum pumps shall be as manufactured by Cherne Industries, Inc. or prebid Engineer approved equal.
  2. Contractor shall adhere to the following procedure:
    - a. All lift holes shall be plugged.
    - b. All pipes entering the sanitary sewer manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the sanitary sewer manhole.
    - c. The test head shall be placed at the top of the sanitary sewer manhole in accordance with the Manufacturer's recommendations.
    - d. A vacuum of 10-inches of mercury shall be drawn on the sanitary sewer manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9-inches of mercury.
    - e. The sanitary sewer manhole shall pass if the time for the vacuum reading to drop from 10-inches of mercury to 9-inches of mercury meets or exceeds the values indicated in Sanitary Sewer Manhole Vacuum Test Table.
    - f. If the sanitary sewer manhole fails the initial test, necessary repairs shall be made by an approved method. The sanitary sewer manhole shall then be retested until a satisfactory test is obtained.

Table 9 - Sanitary Sewer Vacuum Test Table

Minimum Test Times for Various Depth and Manhole Sizes			
MH Inside Diameter, (inches)			
	48	60	72
Depth, (ft)	Time, (seconds)	Time, (seconds)	Time, (seconds)
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113

D. Sanitary Sewer Sanitary Manhole Exfiltration Test:

1. The sanitary sewer manhole water exfiltration test shall only be allowed where specified.
2. To perform this test, the inlet and outlet of the sanitary sewer manhole shall be plugged and the sanitary sewer manhole filled with water to a depth equal to that used for the sanitary line water test, or in the case when the air test was run on the line, a minimum depth of 2-feet above the top of the sewer line or 2-feet above the existing ground water - whichever is the higher.
3. Allow the water to stabilize for 1/2-hour and refill the sanitary sewer manhole to the original elevation. Mark the initial depth of the water, and after 1-hour record the drop in the water level in the sanitary sewer manhole.
4. The maximum allowable drop in vertical water height in the sanitary sewer manhole shall be 1/4-inch for all diameter sizes of sanitary sewer manholes. If the water level in the sanitary sewer manhole drops below the allowable drop amount, the Contractor shall repair the leak and retest.



**Brookings Municipal Utilities (BMU)**  
**Standard Specifications**  
**For**  
**Water Main Construction**  
(City of Brookings)

Revision Date: February 18, 2020

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## **PART 1.0 - GENERAL REQUIREMENTS**

### **1.1 SCOPE OF WORK**

- A. The Contractor shall furnish all the necessary labor, materials, equipment, tools, and supplies that are necessary to install a complete water main system, as shown on the plans, standard plates and/or called for in these specifications or its addenda.

### **1.2 WARRANTY PERIOD**

- A. The corrective period of three (3) years shall commence from the BMU determined Substantial Completion date. The corrective period shall cover the contract as to workmanship and materials for a period of time as specified in the City of Brookings "EXCAVATING & BACKFILLING ON PUBLIC RIGHT-OF-WAY" Ordinance.
- B. The Contractor shall be held responsible for workmanship, materials, settling trenches or any other deficiencies in the water main system during the corrective period. The Contractor shall repair and/or replace all deficiencies in the water system during the three (3) years corrective period at no cost to the Owner. Any surface restoration costs incurred because of the repairing and/or replacing of deficiencies in the water system shall be borne by the Contractor.

### **1.3 CONTRACTOR LICENSE AND PERMITS**

- A. The Contractor shall be required to have any required licenses (sanitary sewer and water installation Contractor license or sanitary sewer and water installer license) for water/sewer installation or water/sewer repairing as stated in the South Dakota State Plumbing Code.
- B. The Contractor shall obtain an "EXCAVATION PERMIT" issued at no charge from the Brookings City Engineering Office before any water/sewer installation or water/sewer repairing will be allowed.
- C. The Contractor shall obtain any "DEWATERING PERMITS" required from local, state or federal agencies. The discharge area must be prior approved by the Engineer before initiating the dewatering.

### **1.4 BMU FURNISHED MATERIALS & WATER SERVICE TAPPING FEES**

- A. If indicated on the project plans and/or as indicated on the project bid form, BMU shall furnish fire hydrants and isolation valves to the Contractor to install.
- B. BMU provided fire hydrants and isolation valves shall only be used for the operation of BMU water mains in utility easements or public right-of-ways as identified in the executed Application to Connect.
  - 1. BMU Provided Fire Hydrants, Gasket and Bolts
    - a. On projects that BMU is providing the fire hydrants, BMU shall be responsible for providing fire hydrants, gasket and bolts for each hydrant

identified in the plans. BMU shall be responsible for providing fire hydrants with bury depths as indicated in the project plans.

- b. If a hydrant extension is needed to accommodate the indicated bury depth, BMU will provide and install the hydrant extension.
- c. Concrete blocking, tracer wire, grounding rod, restrain joint, hydrant markers and other associated hardware shall be furnished and installed by the Contractor.
- d. Contractor is responsible for including any and all taxes, included but not limited to excise tax, sales tax, and use tax, in the established bid price for all BMU provided fire hydrants.

2. BMU Provided Valves

- a. On projects that BMU is providing the isolation valves, BMU shall be responsible for providing only the valve for each location identified in the plans.
  - b. Gaskets, bolts, concrete blocking, restrain joints, valve boxes, lids and other associated hardware shall be furnished and installed by the Contractor.
  - c. Contractor is responsible for including any and all taxes, included but not limited to excise tax, sales tax, and use tax, in the established bid price for all BMU provided fire hydrants.
- C. Contractor shall be responsible for payment to BMU for all water tapping fees. Water tapping fees shall be charged to the Contractor at the cost identified on the BMU annually published "SERVICE CHARGES – WATER/SEWER" rate sheet.
- 1. The Contractor will be responsible for furnishing all pipe saddles and corporation stops needed to complete the project.
  - 2. BMU shall install the saddle, drill and tap the water up to and including 2-inch corporations. Upon completion of work, BMU will generate an invoice and will bill accordingly. Water services 2-inch or larger shall require prior BMU approval.

1.5 QUALITY CONTROL

- A. Testing and/or retesting of materials because of nonconformance to the specified requirements shall be performed by an independent firm as per the instructions of the Engineer of Record.
- B. Payment for retesting performed during the Contract period and during the warranty period will be the responsibility of the Contractor.

1.6 SUBMITTALS

- A. The Contractor shall submit the number of copies that the contract requires plus one copy that the Engineer of Record will retain. The Contractor shall obtain shop drawing approval before any of the work related to that material is performed.

- B. Shop drawings and data shall be submitted for, but not be limited to, the following items:
  - 1. Pipe, pipe fittings, bedding material, stabilization material, road topping material, and any other pertinent information concerning construction materials that the Engineer of Record deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.
- C. The Contractor shall submit appropriate documentation to the Engineer of Record for any materials not listed in these specifications. The Engineer of Record may forward any shop drawing to the BMU Engineer for consideration. Correspondence shall indicate any discrepancies between the BMU specification requirements and the Contractor provided submittal.
  - 1. BMU Engineer reserves the right to reject any and all materials that do not meet the requirements for water mains as indicated in these standard specifications.
- D. If a Temporary Water Main Bypass System is deemed necessary by the Engineer of Record, the Contractor shall submit a comprehensive Temporary Water Main Bypass Plan to the BMU Engineer for approval.

#### 1.7 TRAFFIC CONTROL

- A. The Contractor shall furnish, install and maintain any and all traffic control devices as required by the project plans. All traffic control devices shall be provided and installed according to the manual on "Uniform Traffic Control Devices" for streets & highways whenever applicable. The Federal Highway Administrator approves this manual as the National Standard.

#### 1.8 GEOTECHNICAL REPORT

- A. In the event that a geotechnical report, prepared by a licensed South Dakota Professional Engineer, exists for the proposed project, the requirements of that report shall be strictly adhered to.
- B. Any requirements for, but not limited to compaction requirements, dewatering, testing frequency, the need for imported materials or trench stabilization included in the geotechnical report shall be followed regardless of the specific requirements in the following subsections.

**PART 2.0 - PRODUCTS****2.1 TRENCH STABILIZATION MATERIAL**

- A. In poor trench conditions, or if directed by the BMU Engineer's Representative, the Contractor shall be required to use trench stabilization consisting of 3/4-inch to 4-inch crushed angular, well-graded material.
- B. Larger crushed angular material may be required if deemed necessary by the BMU Engineer's Representative to stabilize the bottom of the trench.
- C. The use of trench stabilization material will not eliminate the need for pipe bedding material.

**2.2 PIPE BEDDING MATERIAL**

- A. Contractor shall use 1/4" x 3/4" clean angular crushed rock for pipe bedding, with the following minimum percentage gradation requirements:

*Table 1- Pipe Bedding Gradation*

<b>Sieve Size</b>	<b>Percentage Passing</b>
<b>1-inch</b>	100%
<b>3/4-inch</b>	85% to 100%
<b>1/2-inch</b>	15% to 85%
<b>#4</b>	0% to 15%

**2.3 IMPORTED ENGINEERED FILL MATERIAL**

- A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported engineered fill material for backfilling the water trench.
- B. Imported engineered fill material shall be a granular material conforming to requirements for "PIT RUN" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING", processed sand or gravel having a maximum particle size of 1-inch.

**2.4 IMPORTED CLAY MATERIAL**

- A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported clay backfill material for backfilling the water trench.
- B. Clay material is available from the Brookings Regional Landfill (605-693-3667). Contractor shall be responsible for contacting the landfill to determine the availability and cost of the material. Contractor shall be responsible for loading, hauling and placing the clay material.
- C. The moisture content of the imported clay material shall be 1 to 4% below the optimum moisture content at time of placing and compacting the material. The

Contractor shall be responsible for drying material to obtain the optimum moisture conditions.

## 2.5 AGGREGATE BASE MATERIAL

- A. Aggregate base material shall be provided at any location where a hard road surface (concrete or asphalt) will be placed over the water main trench.
- B. The aggregate base material shall conform to requirements for "AGGREGATE BASE COURSE" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING".
- C. The 3/4-inch granular material, unless otherwise directed, shall conform to the following sieve analysis:

*Table 2- Imported Granular Material Gradation*

Sieve Size	Percentage Passing
<b>1-inch</b>	100%
<b>3/4-inch</b>	80% to 100%
<b>1/2-inch</b>	68% to 91%
<b>#4</b>	46% to 70%
<b>#8</b>	34% to 58%
<b>#40</b>	13% to 35%
<b>#200</b>	3% to 12%

## 2.6 GRAVEL SURFACING MATERIAL

- A. The gravel surfacing or road topping material shall conform to requirements for "GRAVEL SURFACING" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING".
- B. The 3/4-inch gravel surfacing material with a soil mortar or binder, unless otherwise directed, shall conform to the following sieve analysis:

*Table 3- Crushed Gravel Gradation*

Sieve Size	Percentage Passing
<b>3/4-inch</b>	100%
<b>#4</b>	50% to 78%
<b>#8</b>	37% to 67%
<b>#40</b>	13% to 35%
<b>#200</b>	4.0% to 15%

## 2.7 POLY VINYL CHLORIDE (PVC) WATER MAIN PIPE

- A. Water main pipe 4-inches in diameter and greater shall be Poly Vinyl Chloride (PVC) with a gasket joint. Pipe shall sustain a working pressure of 150 pounds per square inch (psi). Pipe classes shall be as follows:

Table 4- PVC Water Main Material

Pipe Size	PVC Pipe Type
4" – 12"	C900 DR 18
14" – 48"	C905 DR 18

- B. All PVC pipe shall be manufactured in full conformance with the most current edition of AWWA C900 and C905 Standards. All PVC pipe shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.
- C. Sealing pipe joints for all C900 and C905 PVC pipe shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. All gaskets shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects.
- D. Acceptable Manufacturers are Diamond, JM Eagle, or prebid BMU Engineer approved equal.

## 2.8 RESTRAINT JOINT PVC WATER MAIN PIPE

- A. Restraint Joint PVC Pressure pipe shall be manufactured in accordance with the dimensions, materials, quality control and markings specifications found in AWWA C900/C905.
- B. PVC Material shall conform to a minimum cell classification of 12454 as defined by ASRM D1784. The pipe compound is listed as standard grade material with a Hydrostatic Design Basis (HDB) of 4000 psi.
- C. Pipe system shall utilize a restrained joint utilizing a precision-machined groove on the pipe spigot and inside the pipe bell or coupling. A spline shall be inserted through an entry hole in the pipe bell, resulting in a continuous circumferential restrained joint that locks the pipe segments together.
- D. Pipe classes shall be as follows:

Table 5- PVC Water Main Material

Pipe Size	PVC Pipe Type
4" – 12"	C900 DR 18
14" – 48"	C905 DR 18

- E. All PVC pipe and gasket materials shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.
- F. All PVC pipe supplied for potable water applications shall be blue in color. Standard pipe laying length on 20 feet shall be provided unless otherwise specified on project plans.
- G. Acceptable Manufacturers are NAPCO Certa Lok , Certainteed Yelomine or prebid BMU Engineer approved equal.

## 2.9 TRACER WIRE FOR WATER MAINS

- A. Tracer Wire – Direct Bury

1. All components of the tracer wire system shall be suitable for direct bury applications. The conductor shall be 12 AWG, solid, soft-drawn copper, with a minimum insulation thickness of 0.045-inches of high molecular weight polyethylene, and shall be blue in color.
  - a. Acceptable Manufacturers for direct bury tracer wire shall be CCI, Kris Tech, Copperhead or prebid BMU Engineer approved equal.
2. Splice kits shall utilize Scotchlok Y electrical spring connector, to electrically connect two or more pre-stripped copper wire ends in a pigtail application and moisture seal the connection for direct burial. The device shall be UL listed as wire connector system for use with underground conductors.
  - a. Acceptable Manufacturers for splice kit shall be 3M DBR/Y or prebid BMU Engineer approved equal.

C. Tracer Wire – Pipe Burst or Directional Drill

1. The conductor shall be 12 AWG, 21% conductivity copper-clad hard drawn high carbon steel with copper cladding, pipe burst and extreme horizontal directional drill tracer wire, 4,700 lb average tensile break load, 50 mil high molecular weight-high density polyethylene jacket complying with ASTM D1248, 30 volt rating. Tracer wire shall be blue in color.
  - a. Acceptable Manufacturers for pipe bursting or directional drill tracer wire shall be Copperhead Soloshot Xtreme PBX-50 or prebid BMU Engineer approved equal.
2. Splice kits shall provide water-proof, corrosion-proof dielectric sealant that protects wires and prevents breaks in wire conductivity. Splice kit shall be provided with a clear body to view/verify that wires are fully inserted into splice kit. Splice kit shall utilize 90-degree twist-lock design that makes wire connections easy and keeps wires locked in place.
  - a. Acceptable Manufacturers for splice kits in pipe bursting or directional drill applications shall be Copperhead SnakeBite or prebid BMU Engineer approved equal.

D. Ground Rod

1. Ground rods, shall be pointed copperbonded ground rods, 1/2-inch diameter, 60-inch long steel rod uniformly coated with 5-mil metallically bonded electrolytic copper.
2. Acceptable Manufacturers for ground rods shall be Erico, Nvent, Eritech 611350 or prebid BMU Engineer approved equal.

E. Ground Rod Clamps

1. Ground rod clamps shall be standard duty bronze rod clamp used to attach ground wire to rod. Rod clamp size shall retain up to 10 solid conductors. Rod clamp shall be suitable for direct burial and UL listed for direct burial in earth or concrete.
2. Acceptable Manufacturers for ground rod clamps shall be Erico, Nvent, Eritech CP58 or prebid BMU Engineer approved equal.

## 2.10 WATER MAIN FITTINGS

- A. Mechanical joint water main fittings with accessories, 3-inch through 48-inch shall be manufactured from ductile iron in accordance with and meet all applicable terms and provisions of standard ANSI/AWWA C153/AWWA C111.
- B. Ductile Iron mechanical joint fittings 3-inch through 24-inch shall be rated for 350 psi working pressure. Fittings 30-inch through 48-inch shall be rated for 250 psi working pressure.
- C. All fittings shall be cement lined on the interior and 1-mil nominal thickness bituminous coated on the exterior as specified for cast iron fittings. Coating and cement lining shall be manufactured in full conformance with the most current edition of ANSI/AWWA C104/A21.4.
- D. Mechanical joint fittings shall be provided with gaskets, glands, bolts, and other appurtenances.
- E. Acceptable Manufacturers are Sigma, Star, Tyler-Union or prebid BMU Engineer approved equal.

## 2.11 BOLTS, NUTS, GASKETS AND OTHER HARDWARE

- A. Bolts shall be fluorocarbon coated (Cor-Blue) low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11.
- B. Gaskets shall SBR rubber and shall be resistant to water containing normal concentrations of chloramine. Gaskets shall meet NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372 approved for contact with drinking water.

## 2.12 COUPLING ADAPTORS

- A. Coupling adaptor shall be suitable for all pipe materials including Ductile Iron, Cast Iron, Steel and PVC. Provide a long body design that provides extra flexibility and allows connecting pipe of two different pipe materials.
- B. Coupling adaptor shall meet AWWA C219 and NSF 61 requirements. Gaskets shall be provided with Ethylene Propylene Monomer Rubber (EPDM) compound suitable for water and sewer service in accordance with ASTM D2000 and NSF 61.
- C. Product shall be available in pipe nominal diameter ranging from 1.5-inch to 24-inch. Coating on coupling adaptor shall be 100% fusion bonded epoxy for corrosion protection. Minimum coating thickness shall be 12 mils.
- D. Coupling shall be provided with integral AISI 3054 Stainless steel all thread, bolts, washers and nuts.
- E. Acceptable Manufacturers are Krausz Hymax Long Body, Romac Macro or prebid BMU Engineer approved equal.

## 2.13 MECHANICAL JOINT RESTRAINER DEVICES

- A. Restraining mechanisms shall be with wedges or full circle contact and support of the pipe wall. Restraint shall be accomplished by a series of ring or wedge segments mechanically retained inside the gland housing and designed to grip the pipe wall in an even and uniform manner.
- B. Restraining devices shall be actuated by bolts featuring twist-off heads to ensure proper installation torque is applied. All components of the restrainer, including the gland, bolts, and restraint segments, shall be of high-strength ductile iron and shall be manufactured in full conformance with the most current edition of ASTM A536.
- C. Restrainer devices shall be coated with 12-mil 100% fusion bonded epoxy body with fluorocarbon coated ring/wedge.
- D. Appropriate restrainer devices shall be supplied for the specific type of piping material being used on the project.
- E. Acceptable Manufacturers are EBAA Iron Inc., Megalug Flanges, Romac Industries, RomaGrip DI Grip Rings, Star Products Stargrip, Tyler Union TuFGrip Series 2000 or prebid BMU Engineer approved equal.

## 2.14 BELL RESTRAINER DEVICES

- A. Restraint for PVC pipe (AWWA C900 or C905 CI O.D.) at the bell shall consist of the following:
  - 1. The restraint shall be manufactured of ductile iron conforming to ASTM A536. A solid, non-split, backup ring shall be used behind the PVC bell.
  - 2. A restraint ring, incorporating a plurality of individually-actuating gripping surfaces, shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.
  - 3. Restrainer devices shall be coated with 12-mil 100% fusion bonded epoxy body with fluorocarbon coated ring/wedge..
- B. Acceptable Manufacturers are for bell restrains shall be EBAA Iron Series 2800, or prebid BMU Engineer approved equal.

## 2.15 GATE VALVES

- A. Resilient wedge gate valves (4-inches to 30-inches) shall utilize ductile iron components and be manufactured in full conformance with the most current edition of AWWA C515. The valve seat shall be rated for 250 psi cold water working pressure.
- B. Valves shall have a ductile iron 2-inch ductile iron operating nut and open left (counter-clockwise).
- C. Gate valves shall be provided with mechanical joint connections meeting the requirements of AWWA C111.

- D. All valves supplied shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.
- E. Valves shall have a ductile iron wedge encapsulated with nitrile rubber or an EPDM rubber compound. Wedge shall be symmetrical and seal equally well with flow in both directions. Resilient seats shall be bonded or mechanically attached to the gate.
- F. Stems shall be non-rising, bronze or stainless steel, and shall be sealed by three O-rings.
- G. All exterior bolting, including but not limited to bonnet and stuffing box bolts, shall be 304 stainless steel. Seal between bonnet and valve body shall utilize a flat gasket with integral O-ring; therefore, allowing bolting to pass through and hold the gasket in place.
- H. All internal and external ferrous surfaces shall have a 100% fusion bonded epoxy coating applied electrostatically prior to assembly meeting the requirements of AWWA C550.
- I. Tapping valves shall meet all the requirements specified within this section. Tapping valves shall have a mechanical joint end and a flanged end to correspond to the branch flange of the tapping sleeve
- J. Acceptable Manufacturers are Waterous, American AVK, American Flow Control (AFC), Mueller or prebid BMU Engineer approved equal.

## 2.16 VALVE BOXES AND COVER

- A. Valve box shall be a 2 or 3 piece cast iron valve box for 4-inch to 12-inch gate valves. Valve box shall be adjustable for required trench depth.
- B. Valve boxes shall be domestic (heavy wall) cast iron and shall include all pieces as required for installation. The valve boxes shall meet the following requirements:
  - 1. 5 1/4-inch shaft.
  - 2. Standard drop covers marked "WATER."
  - 3. Screw-type.
  - 4. Circular base for 8-inch valve.
  - 5. Heavyweight 35,000-pound tensile strength.
  - 6. Adjustable for trench depth.
  - 7. Covers shall have a skirt length of 1 1/2-inch.
  - 8. Extensions shall be in lengths shown and be compatible with the valve boxes bid.
- C. The valve box top section extensions and caps shall be compatible with the above valve box specifications.
- D. Acceptable Manufacturers are Sigma, Star, Tyler or prebid BMU Engineer approved equal.

## 2.17 VALVE BOX ADAPTOR

- A. Valve box adaptor shall be manufactured from recycled "Green" rubber compound. Adaptor shall be custom-molded for a precise fit on all types and sizes of gate valves 2-inch through 16-inch and can be used with 5 1/4-inch cast iron valve boxes.
- B. Valve box adaptor shall be installed between the valve and valve box to eliminate settling and shifting of the valve box over the gate valve, allow proper keying of the valve, and center valve box over the operating nut.
- C. Acceptable Manufacturers are VBA-II by Adaptor Inc. or prebid BMU Engineer approved equal.

## 2.18 FIRE HYDRANTS

- A. Fire hydrants shall be open left (counterclockwise), constructed of ductile iron nozzle section, including but not limited to caps, upper/lower standpipes and hydrant base, and meet or exceed AWWA C502, latest revision. The hydrant shall be rated for a working pressure of 250-psi.
- B. The section of the hydrant above ground shall be painted with epoxy primer and high-gloss urethane coating. Hydrants shall be provided with Red coating. Hydrants shall be capable of being extended in 6-inch increment (7'6", 8'0", 8'6", 9'0" and 9'6") and shall be equipped with traffic features that include a breakaway flange and stem with a shaft coupling.
- C. Nozzle section shall be designed for easy 360 degree rotation by loosening connecting bolts and rotating entire nozzle section.
- D. Fire hydrant shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.
- E. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure. The main valve opening shall not be less than 5 1/4-inches and be designed so that removal of all working parts can be accomplished without excavating.
- F. Hydrant shall be provided with an internal travel stop nut located in the top-housing of the hydrant. A double oil reservoir to lubricate the operating threads of the hydrant and utilize a O-ring to seal interior components from water, moisture and foreign materials.
- G. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod.
- H. Hydrants shall have two 2 1/2-inch hose nozzles and one 4 1/2-inch pumper nozzle, all located on the same horizontal plane. The centerline of the nozzles shall be 24-inches above the ground line groove (16" upper barrel section). Operating nuts shall be pentagon shaped and measure 1 1/2-inches point to flat. Nozzle cap nuts shall be the same dimension and shape as the operating nuts, and the nozzle caps shall be furnished with security chains.

- I. All internal and external threads and bolting shall be National Standard threads and utilize a nut and bolt design. Metric, or allen bolts will not be acceptable. All below grade exterior bolting shall be constructed of 304 stainless steel.
- J. Provide fire hydrants with a 6-inch mechanical joint connection. Bolts shall be fluorocarbon coated low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11.
- K. Acceptable Manufacturers are Waterous Pacer WB67-250 or prebid BMU Engineer approved equal.

#### 2.19 FIRE HYDRANT MARKER

- A. Hydrant marker shall be impregnated polycarbonate material, red color with adhesive reflector, and with a flexible galvanized hinge riveted to hydrant marker.
- B. Each marker shall be hinge mounted to bonnet with bonnet bolt at 48-inch length and 3-inch width.
- C. Fire hydrant markers to be the FH 800 Series American model manufactured by Flexstake or prebid BMU Engineer approved equal.

#### 2.20 WATER SERVICE PIPE (1-inch, 1.5-inch or 2-inch)

- A. Crosslinked Polyethylene (PEX)
  - 1. Crosslinked Polyethylene (PEX) shall be a minimum pressure class of 200 psi, and shall conform to the most current edition of ANSI/AWWA C904.
  - 2. Pipe shall have a co-extruded UV Shield made from UV-resistant high-density polyethylene, color blue. Fittings and valves shall meet the requirements of AWWA C800 and ASTM B62.
  - 3. PEX pipe shall be either 1-inch, 1.5-inch or 2-inch nominal diameter. No other size is acceptable and shall not be provided.
  - 4. Acceptable Manufacturers are Rehau-Municipex or prebid BMU Engineer approved equal.
- B. Copper
  - 1. Copper pipes shall be U.S. Government Type K soft copper tubing. Fittings and valves shall meet the requirements of AWWA C800 and ASTM B62.
  - 2. Type K Copper pipe shall be either 1-inch, 1.5-inch or 2-inch nominal diameter. No other size is acceptable and shall not be provided.
  - 3. Acceptable Manufacturers are Cambridge-Lee Copper, Cerro, Halstead, Mueller Copper Company, and Wolverine or prebid BMU Engineer approved equal.

#### 2.21 CURB STOPS (1-inch, 1.5-inch or 2-inch)

- A. No lead brass curb stop with copper tub size (CTS) compression connection shall be Minneapolis pattern valves, conforming to the latest revision of the

ANSI/AWWA C800 Standard for Underground Service Line Valves and Fittings, or prebid BMU Engineer approved equal.

- B. Curb stops shall not be the drain back type.
- C. Acceptable Manufacturers are A.Y. McDonald 6104, Ford B-22, Mueller B-25154 or prebid BMU Engineer approved equal.

## 2.22 CURB STOP BOX

- A. Curb stop box shall be adjustable and include a base tapped to attach to the threaded top of a Minneapolis pattern curb valve. The upper part of the box is adjustable and telescopes in the base to allow for grade adjustments.
- B. Box shall be furnished with a cast iron lid and brass pentagon plug. Lid shall be provided with a stainless steel screw for attaching tracer wire to the lid.
- C. Curb box shall be provided with an electrostatically applied, cationic epoxy coating system that provides complete corrosion protection.
  - 1. If an epoxy coating cannot be provided on the curb stop box, the cast iron curb stop box shall be furnished and installed with a 5 lb anode bag.
- D. All curb stop boxes shall be provided with 60" steel stationary rod with ductile iron tee head socket and brass cotter pin.
- E. Acceptable manufacturers for curb boxes shall be Ford EM2-XX-56-XXR-TW Series or BMU Engineer approved equal.

## 2.23 DOUBLE CHECK VALVE BACKFLOW ASSEMBLY (1/2-inch - 2-inch)

- A. Double check valve assembly shall be designed to protect drinking water supplies from dangerous cross-connection in accordance with national plumbing codes. The assembly shall consist of two (2) positive seating check modules with captured springs and rubber seat discs.
- B. The check module seats and seat disc shall be replaceable single cover, top entry cover that allows for convenient access for maintenance.
- C. The assembly shall also include two (2) resilient seated, quarter turn isolation ball valves and four (4) top mounted resilient seated test cocks.
- D. The assembly shall meet the requirements of latest revision of the ASSE STD 1015 and AWWA C510
- E. Acceptable manufacturers for double check valve backflow assembly are: Watts Series LF007, or BMU Engineer approved equal.

## 2.24 PIPE INSULATION

- A. Water main insulation shall be an extruded polystyrene board and meet the requirements of ASTM C578, Type IV. The minimum R-value shall be 5.0 as determined by ASTM C518. The minimum compressive strength shall be 25-psi as determined by ASTM D1621. The maximum water absorption shall be 0.1-percent by volume as determined by ASTM C272. The maximum water vapor permeability shall be 1.1-perm as determined by ASTM E96.

- B. Water main insulation shall be STYROFOAM™ Square Edge by the Dow Chemical Company, STYROFOAM™ Brand Scoreboard by the Dow Chemical Company, or prebid BMU Engineer approved equal.

## 2.25 ENCASEMENT PIPE - PVC

- A. PVC encasement pipe shall meet the requirements of the "RESTRAINT JOINT PVC WATER MAIN PIPE" specification included in this specification.

## 2.26 ENCASEMENT PIPE - STEEL

- A. Steel casing pipe shall be ASTM A53 or ASTM A139 welded pipe with a minimum yield strength of 35,000 psi.
- B. Pipe shall be full circumference welded joint in accordance with AWS D1.1 to withstand excavation forces.
- C. Minimum wall thickness and diameter shall be provided as shown in the following table:

*Table 6- Steel Encasement Pipe Material*

Carrier Pipe Size	Carrier Pipe Type	Wall Thickness
<b>4" – 12"</b>	C900 PVC, DR 18	0.250"
<b>16"</b>	C905 PVC, DR 18	0.312"
<b>20"</b>	C905 PVC, DR 18	0.375"
<b>24"</b>	C905 PVC, DR 18	0.438"
<b>30"</b>	C905 PVC, DR 18	0.500"
<b>&gt;36"</b>	C905 PVC, DR 18	0.563"

## 2.27 CASING SPACERS

- A. Casing spacers shall be constructed of circular T-304 stainless steel segments, which bolt together forming a shell around the carrier pipe. T-304 stainless steel bolts and nuts shall be supplied with the spacers.
- B. The spacers shall be designed with risers (when needed) and runners to support and center the carrier pipe within the casing pipe and maintain a clearance of 1/2-inch to 1-inch maximum between the casing pipe inside diameter (ID) and the spacer outside diameter (OD).
- C. The band shall be manufactured of 8-inch (SSI-8) or 12-inch (SSI-12-2) wide, 14-gauge T-304 stainless steel. The risers shall be constructed of T-304 stainless steel having a minimum length of 6-inches (SSI-8) or 10-inches (SSI-12-2).
- D. Abrasion-resistant runners, having a minimum length of 7-inches (SSI-8) or 11-inches (SSI-12-2), and a minimum width of 2-inches, shall be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material shall be of glass reinforced plastic with the following minimum properties:
1. compression strength of 25,000-psi,

2. flexural strength of 32,000-psi, and
  3. tensile strength of 22,000-psi.
- E. The ends of all runners shall be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.
  - F. On carrier pipes with an OD of 16-inches or less, each spacer shall have four riser/runner combinations-two on each half. On carrier pipes with an OD of 20-inches and greater, the number of riser/runner combinations shall be as recommended by the Manufacturer, with four being the minimum.
  - G. Interior surfaces of the stainless steel shell shall be lined with EPDM having a minimum thickness of 0.090-inches with a hardness of durometer "A" 85-90. Placement of the spacers shall be a maximum of 1-foot on each side of the bell joint and one every 6 to 8-feet thereafter.
  - H. Casing spacers shall be Model SSI-8 for carrier pipes 24-inches in diameter and smaller and Model SSI-12-2 for carrier pipes 30-inches in diameter and greater as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

#### 2.28 CASING END SEALS

- A. Full conical-shaped wraparound seals made of 1/8-inch-thick neoprene rubber shall be provided for each end of the casing pipe. T-304 stainless steel banding straps with a 100-percent nonmagnetic worm gear mechanism and pressure sensitive butyl mastic strips shall be provided to seal edges.
- B. End seals shall be Model AW Wraparound casing end seals as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

#### 2.29 TEMPORARY WATER MAIN BYPASS PIPE

- A. Temporary water/water main bypass pipe and associated appurtenances that may come into contact with water shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.
- B. All PVC piping systems shall be manufactured in full conformance with the most current edition of AWWA C900 and C905 Standards.
- C. Temporary water main shall be a minimum of 2-inch diameter unless otherwise specified.
- D. Approved Products are CertainTeed-Certa-Lok Yelomine or prebid BMU Engineer approved equal.

#### 2.30 GALVANIC ANODES

- A. Anodes utilized for typical galvanic anode system installation are prepackaged magnesium style anodes weighing five (5) or eighteen (18) pounds. Anode composition is to be in accordance with ASTM B843-2003 Table 1, Grade HP, M1C.

- B. Anodes are to be packaged in a low resistive backfill consisting of seventy-five percent (75%) gypsum, twenty percent (20%) bentonite, and five percent (5%) sodium sulfate.
- C. Anodes shall be provided with #10 AWG stranded copper, single-conductor cable with HMWPE insulation. Lead wire cable shall be rated for six hundred (600) volts and designed for direct burial applications.
- D. Lead wires must be of sufficient length for splice-free routing between the anode and the pipe and is to be #10 AWG stranded copper, single-conductor cable with HMWPE insulation. Lead wire cable must be rated for six hundred (600) volts and designed for direct burial applications.
- E. Equipment and materials used to bond the #10 AWG HMWPE to the pipeline is of the "CADWELD" type as manufactured by ERICO Products, Inc. of Cleveland, Ohio, or approved equal. Thermite weld caps, designed to protect the CADWELD bonds from corrosion, is to be Royston "Handy Cap 2" or approved equal.

#### 2.31 TAPPING SADDLE

- A. Saddle body and strap are to be permanently held together with a silicon bronze pin for saddles sized 2" thru 8". Saddles 10" and larger shall utilize a two (2) or three (3) piece bolted design. O-ring seal between tapping saddle and pipe shall be made of EPDM. Threads are to be CC Taper.
- B. Water service saddles shall be intended for use on C900 PVC water main.
- C. No lead brass is to conform to AWWA Standard C800 (Latest Revision). Tapping saddles shall have a maximum nominal outlet diameter of 2".
- D. Acceptable Manufacturers for tapping saddle are Ford Meter Box S90, AY McDonald 3895 or prebid BMU Engineer approved equal.

#### 2.32 CORPORATION STOPS

- A. Corporation stops shall be a quarter turn (1/4) ball type, full 100% flow opening valve with compression outlet. Corporation stop shall be rated for 300 psi working pressure. Corporation Stop shall be provided as the same size as service piping.
- B. All brass that comes in contact with water shall be no lead and manufactured in full conformance with AWWA Standard C800 (Latest Revision). Product shall have the letters "NL" cast into the main body for lead-free identification.
- C. Inlet Threads are to be AWWA/CC Taper. Outlets shall utilize a EPDM rubber gasket to provide hydraulic seal and pack joint compression nut to secure outlet pipe.
- D. Acceptable Manufacturers for corporation stops are Ford Meter Box FB1000, AY McDonald 74701B-22 or prebid BMU Engineer approved equal.

### 2.33 PACK JOINT COUPLING

- A. All brass that comes in contact with water shall be no lead and manufactured in full conformance with AWWA Standard C800 (Latest Revision). Product shall have the letters "NL" cast into the main body for lead-free identification.
- B. Coupling shall include pack joint nuts for CTS. Provide a beveled EPDM rubber gasket to provide hydraulic seal on pipe material. Coupling shall have anti-friction washer, integral clamp containing machined grooves for axial restraints and stainless steel screw to activate clamp.
- C. Manufacture shall provide pack joint to match a wide variety of pipe materials including, PVC, PEX, Copper, and HDPE and a variety of different sizes.
- D. Acceptable Manufacturers for corporation stops are Ford Meter Box C44-XX-NL AY McDonald 74758-XX or prebid BMU Engineer approved equal.

### 2.34 BLOW-OFF ASSEMBLY

- A. Blow-off assembly shall consist of a restrained cap that installs on a plain-end piece of pipe, galvanized piping isolation valve and fittings necessary to route flow to surface.
- B. Restrained cap shall be fusion bonded epoxy, ductile iron material meeting ASTM A536 and utilize integral gripper rings to grip the pipe. Draw hooks shall be fabricated from 304 stainless steel. Cap shall have a threaded 2-inch bung to allow connection of piping. Restrained cap shall be Alpha EC as manufactured by Romac.
- C. Provide 2-inch galvanized piping and fittings to plumb water from the restrained cap to the surface. Include 2-inch curb stop and box to isolate flow.

## **PART 3.0 - EXECUTION**

### **3.1 OWNER OPERATE**

- A. No valve, hydrant or other controls on the existing water distribution system shall be operated for any purpose by the Contractor. BMU staff shall be the only authorized operator of existing valves and hydrants.

### **3.2 NOTIFICATION OF INTERRUPTION OF SERVICE**

- A. The Contractor shall coordinate with BMU staff of any interruption of water service at least 24-hours before the interruption of water service. BMU Staff shall notify all customers affected by any the water outage.
- B. BMU is providing a courtesy to the Contractor by notifying the customers of a schedule interruption of service. It is the Contractor sole responsibility to develop, communicate and adhere to the schedule that is communicated to the BMU staff. Under no condition does BMU contacting and communicating directly with the customers relieve the Contractor of the requirements of the General Conditions of any other requirements identified in the Contract Documents.
- C. Customers shall be verbally notified and provided an interruption of service notice. In the event a consumer cannot be notified, the Contractor may need to reschedule their work until the customers are notified.
- D. The Contractor shall communicate and initiate operation of valve and/or fire hydrant requests with BMU staff.

### **3.3 ALIGNMENT AND GRADE**

- A. The Engineer of Record shall furnish all the necessary line and grade stakes, benchmarks, or other necessary control.
- B. It is the responsibility of the Contractor to protect these stakes, and any replacement of stakes shall be at the expense of the Contractor.
- C. The Contractor shall carry alignment and grade into the trench by means of an approved laser beam system and by a surveying level instrument. At no time shall the Contractor change the grade without Engineer of Record and/or BMU Staff approval.
- D. If underground interference is encountered at the assigned grade, the Contractor shall notify the Engineer of Record and wait until the revised grade for the water system has been determined, if necessary. As a secondary check to the laser beam device, the Contractor shall check the grade from the grade stake to pipe invert a minimum of every 100-feet using a surveying level instrument.

### **3.4 WATER PIPE MATERIAL HANDLING & STORAGE**

- A. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by a means to prevent shock or damage. Under no circumstances shall such material be dropped.

- B. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.
- C. Piping shall not be stacked higher than Manufacturers' recommendations according to size. The bottom tier of piping shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; plain end, bell. At least two rows of timbers shall be placed between tiers, and chocks shall be affixed to each timber in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.
- D. PVC piping and Crosslinked Polyethylene (PEX) piping that has been exposed to more than the Manufacturers' maximum allowed UV exposure (sunlight) shall be rejected.
- E. Gaskets for mechanical and push-on joints shall be stored in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
- F. Mechanical-joint bolts shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

### 3.5 MATERIAL INSPECTION

- A. All pipe and appurtenances are subject to inspection by the Engineer of Record and/or BMU staff. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.
- B. Prior to being lowered into the trench, each pipe shall be carefully inspected by the Contractor and those not meeting the specified requirements shall be removed from the site immediately. Rejections may be made for any of the reasons as stated in the specifications for each specific type of pipe. Pipe having minor flaws not serious enough to cause rejection shall be installed so as to bring such flaws in the top half of the sanitary sewer. Pipe shall be protected during handling against impact, shocks, and free fall.
- C. The Engineer of Record and/or BMU staff may perform tests as specified in the applicable AWWA standard to ensure conformance with the standard. In case of failure of the pipe or appurtenance to comply with such specifications, responsibility for replacement of the defective materials becomes that of the Contractor or Manufacturer, even if piping and appurtenance has already been installed.
- D. The Engineer of Record and/or BMU staff may require a test of specimens not to exceed 5-percent of the quantity of pipe to be furnished in order to prove the acceptability of the pipe. The Manufacturer shall provide an approved testing stand near the site of the plant.

### 3.6 BMU ACCESS TO PROJECT SITE

- A. The BMU Engineer or Engineers' Representative shall have access to all parts of the job at all times. The Contractor shall furnish personnel, facilities, equipment,

tools, and materials as are necessary to make whatever tests and inspection that are required by the Contract Documents.

- B. The BMU Engineer reserves the right to inspect and/or reject any part of, or all unsatisfactory work performed by the Contractor. Rejected or unapproved work shall be promptly replaced or modified to comply with these specifications.

### 3.7 REMOVAL OF WATER MAIN AND WATER MANHOLES AND SALVAGING VALVES AND FIRE HYDRANTS

- A. Water main, water manholes, unsalvageable valves, and unsalvageable hydrants shall be removed at the locations shown on the plans or as directed by the BMU Engineer.
- B. Water manholes shall be entirely removed and disposed of by the Contractor.
- C. Valves and fire hydrants shall be salvaged at the locations shown on the plans or as directed by the BMU Engineer. Any salvaged items shall be properly disconnected and transported to Brookings Municipal Utilities (BMU) at 525 Western Avenue and neatly stockpiled. The Contractor shall contact BMU prior to delivery of the materials.

### 3.8 TRENCH EXCAVATION

- A. The Contractor shall excavate to the proper depth and width necessary for the construction of the pipe according to the plans and specifications. The width of the trench at the top of the pipe shall be a minimum of 12-inches on each side of the pipe.
- B. Trenches shall be excavated with vertical sides from pipe flow line to a point 1-foot above top of pipe where possible.
- C. Trench excavation below pipe grade shall be backfilled with bedding material to provide a uniform and continuous bearing and support for the pipe.
- D. Wherever, in the opinion of the Engineer of Record, the bottom of the trench does not afford a reliable or suitable foundation, the trench shall be excavated to such additional depth as is required and replaced with trench stabilization material. Pipe bedding material will be required in addition to trench stabilization material where trench stabilization material is used.
- E. The Contractor will be fully responsible for constructing the water system on a stable base and any defects resulting from improperly preparing the pipe foundation shall be the Contractor's responsibility.

### 3.9 DEWATERING

- A. Water resulting from the dewatering operation shall be disposed of in a manner approved by the Engineer of Record and South Dakota Department of Environment and Natural Resources (SD DENR). It shall not be pumped onto private property without the property Owner's approval. Any damage to property, either public or private, shall be rectified to the satisfaction of the Owner and the BMU. All applicable permits must be obtained by the Contractor before the dewatering operation begins.

- B. Unless otherwise designated on project plans, it is the Contractor's responsibility to investigate soil conditions and/or review included geotechnical reports to determine what dewatering methods shall be required.
- C. Water main installation shall be accomplished in a dry trench. Joints shall not be connected under water. If ground water is encountered, the Contractor shall dewater the trench with suitable pumps and equipment. Lowering of the groundwater level shall be by means of wells, well points, or other suitable means.
- D. The water discharged from the dewatering operations shall not be allowed to wash through any excavated material. The Contractor shall be responsible for any damages that might result from this operation.

### 3.10 WATER MAIN PIPE INSTALLATION

- A. Installation of PVC water main shall conform to the latest revision of AWWA C605 "UNDERGROUND INSTALLATION OF POLYVINYL CHLORIDE (PVC) AND MOLECULARLY ORIENTED POLYVINYL CHLORIDE (PVCO) PRESSURE PIPE AND FITTINGS", and BMU Standard Plates.
- B. Water main shall be installed in the locations shown on the plans or as directed by a BMU representative or Engineer of Record. Water main shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe. Before installing the water main, it shall be cleaned of all foreign matter and kept clean thereafter. Open ends shall be protected at all times to prevent the entrance of dirt, trench water, animals, or foreign matter into the pipe. The bell and spigot shall be wiped clean and sufficient lubrication placed on the gasket and spigot before the pipe is pushed fully into the bell. The lubricant shall be approved for use with potable water.
- C. Water main pipe which is stubbed for future extension shall end with a bell end with a short pipe with cap installed in the bell end which can be removed for future pipe extension.
- D. Field cut spigot ends of push-on joints shall have a square end with beveled edge equal to a factory cut prior to being pushed into the bell. Every pipe shall be bedded uniformly throughout its length with water main bedding material. Care shall be taken to not have any part of the pipe bearing on rocks or stones.
- E. Water main shall have a minimum of 6.0-foot of cover. If 6.0-foot of cover to the top of the pipe cannot be achieved or maintained, the BMU Engineer shall be notified. In special circumstances that 6.0-foot of cover cannot be obtained over the water main, the BMU Engineer may require the use of insulation over or insulation wrapped around the water main pipe.
- F. Pipe shall be carefully installed to line and grade in accordance with line and grade stakes set by the Engineer of Record so that the finished water system will present a uniform alignment. Any noticeable variations from true alignment or grade will be cause for rejection of the work.
- G. The bottom of the trench shall be freed of all rocks and stones and shall be hand shaped and bedded with bedding material as hereafter specified, and the pipe shall be in firm contact with the bedding material for its entire length. At each joint of bell and spigot pipe, a hole shall be dug of sufficient size so that the

weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. Pipe must be properly fitted together.

- H. A suitable plug or cap shall be kept in the end of the pipe so as to prevent any dirt or water from entering during the progress of the work at all times. Any dirt, loose material, or cement mortar which may accumulate in the pipe shall be removed as the work progresses.
- I. Standard length pipe shall be utilized for all installations. Shorter lengths will only be allowed for use at fitting locations.

### 3.11 WATER MAIN CONNECTIONS

- A. To keep interruption of service to surrounding properties at a minimum when making a water main connection, the Contractor shall have all materials for the connection on site, and to the extent possible, have fittings assembled and restrained prior to cutting the existing water main and making the connection.
- B. Pipe cutting shall be neat and completed in a manner so that damage to the pipe, interior lining, or exterior coating. Cutting shall be performed with an approved mechanical cutter, using a wheel cutter when applicable and practical.
- C. Where indicated on plans, the Contractor shall remove an existing plug, cap, reaction blocking or hydrant, prepare the end of the existing water main, and complete the new water main connection.
- D. Where indicated on plans, the Contractor shall cut into an existing water main, prepare the ends of the existing water main, and complete the new water main connection.
- E. Where indicated on plans, the Contractor shall excavate a trench at the water main to install a smith tap into the existing water main. The Contractor will be required to furnish and install the valve box.

### 3.12 TRACER WIRE SYSTEM FOR WATER MAINS

- A. Tracer wire system, including ground rods and all appurtenances, shall be installed with PVC water mains. The wire shall be installed along the lower quadrant of the pipe, but the pipe shall not be laid directly on the wire.
- B. Ground rods shall be installed adjacent to connections to existing piping and in the locations specified on the plans. The tracer wire shall be brought to each fire hydrant and connected to a 60-inch ground rod that extends up to the bottom of the breakaway flange. The ground rod shall be duct taped to the fire hydrant barrel in at least four locations below the ground surface.
- C. Tracer wire shall be installed on all water services. Additional requirements for the installation of the tracer wire on services can be found in the "WATER SERVICES" section.
- D. All underground splices shall be inspected by the Engineer of Record and/or BMU representative prior to backfilling.
- E. Prior to the road surfacing be placed and after the water service connections made, BMU shall be responsible for testing and verifying that the tracer wire has been installed and operates correctly. If the tracer wire system does not function

as intended, the Contractor shall repair the system to the satisfaction of the Engineer of Record or BMU representative. Any costs associated with making the repairs to the tracer wire shall be at the Contractor's expense.

### 3.13 CONCRETE THRUST BLOCKS

- A. The Contractor shall brace all valves, hydrants, fittings, plugs and caps 12-inch in diameter and smaller by means of restrain joint glands and precast concrete thrust blocks.
- B. No wood shimming or bracing will be allowed in conjunction with the concrete blocks.

### 3.14 VALVES AND FITTINGS

- A. Valves and fittings shall be installed at the locations shown on the plans or as directed by the Engineer of Record. Valves and fittings shall be installed in accordance with the most current edition of AWWA C600. Proper precast concrete blocking shall be installed under all valves. Pipe shall be supported in such a manner as to prevent stress on the valve.
- B. Valves and fittings shall remain exposed until the BMU Engineer or Representative has visually inspected and measured the as-built locations.
- C. All mechanical joint valves and fittings shall be installed with two restrainer devices per valve.
- D. All mechanical joint valve and fittings connections shall not exceed a horizontal or vertical deflection of 5-percent. In no case shall valves be used to bring misaligned pipe into alignment during installation.
- E. Valves and associated valve box shall not be located in areas that will be future curb and gutters or valley gutters. Any valve located in these areas will not be acceptable to BMU Engineer and shall be removed and relocated at no expense to BMU.
- F. All new dead-end water mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure. All dead-end water mains shall be equipped with suitable temporary fire hydrant or blow-off assembly.
- G. If a blow-off valve precedes the dead-end plug or cap it shall have two (2) joint restraint devices included, and rodding to a fitting may also be required, to insure the valve does not blow off when extension of the water main resumes.

### 3.15 VALVE BOXES

- A. The Contractor shall adjust the valve boxes to the final grade as shown on the Standard Plates. All buried valves shall be installed with the valve box adapter to allow secure and aligned placement of the valve box on the valve.
- B. The Contractor shall furnish and install valve box extensions (additional sections) as needed if the valve box has inadequate adjustment length remaining or if extra depth water main had been installed that requires the use of an extension.

- C. The Contractor shall replace existing valve boxes as specified. This work includes excavating to the existing valve and removing the existing valve box. A new valve box shall be installed and the trench backfilled.
- D. All valve boxes, new installation and adjustment of existing valve boxes, shall be backfilled with pipe bedding material to a depth as indicated on the BMU Standard Plates. The Contractor shall ensure that valve boxes are plumb prior to and during backfilling.
- E. Valve operating nut within valve boxes shall be clear of any debris. BMU Staff shall check valve boxes so they can be freely operated after backfilling operations, prior to paving, and again prior to the completion of the project. It shall be the Contractor sole responsibility to remove any debris or correct any alignment problems that might prevent BMU staff from properly operating the valve.

### 3.16 FIRE HYDRANTS

- A. Fire hydrants shall be installed at the locations and elevations as shown on the plans or as directed by the Engineer and in accordance with the most current edition of AWWA C600.
  - 1. The centerline of the nozzles shall be a minimum of 24-inches above the finished surface elevation but no higher than 26-inches.
  - 2. The bottom of the breakaway flange shall be a minimum of 2-inches and a maximum of 4-inches above the finished surface elevation.
  - 3. Fire hydrants shall be installed 3 to 5-feet behind the back of curb unless otherwise indicated on the plans, stand plumb, and have their nozzles parallel with or at right angles to the street centerline, with the pumper nozzle facing the street.
  - 4. Hydrants installed near intersections shall be located 5-feet minimum from the intersection sidewalk.
- B. The Contractor and/or supplier will be responsible for providing fire hydrants with the appropriate bury depths. If a hydrant is provided with an unacceptable bury depth, supplier shall furnish the necessary hydrant extension to BMU. BMU will be responsible for installing any extensions needed to install the fire hydrant at the appropriate grade and in accordance with BMU standards. BMU may back-charge the Contractor for the labor necessary to install the hydrant extension.
- C. Hydrants shall be set on a precast concrete block to prevent settlement. Precast concrete thrust blocks shall be installed against undisturbed soil to prevent movement of the hydrant lead.
- D. Hydrant bases shall be backfilled with a minimum of 1/3-cubic yard of pipe bedding material to facilitate drainage from the hydrant weep holes. The bedding material shall be placed at a depth of approximately 36-inches above the hydrant base. Contractor shall install one layer of heavy duty construction grade plastic at the interface of bedding material and the native backfill material. Plastic material shall be installed to minimize fines from migrating into the bedding material and potentially plugging the hydrant weep holes.

- E. Tracer wire and a ground rod shall be installed at each fire hydrant location. Tracer wire and grounding rod shall be installed in strict accordance with BMU requirements indicated in previous sections and standard details.
- F. Flushing hydrants installed for testing purposes shall be removed once testing has been completed. If the flushing hydrants will remain in place for the duration of a winter season, they shall be installed behind the existing or proposed curb and gutter.

### 3.17 GALVANIC ANODES

- A. Anodes are to be installed eighteen to thirty-six inches (18" to 36") from the curb box, to a centerline depth in line with the approximate depth of the curb stop.
- B. The #10 AWG HMWPE lead wires must be attached to the curb stop box. Lead wire connections to the curb box are to utilize exothermic weld connection methodology and follow the manufacturer's instructions for use.
- C. Extreme care shall be taken not to damage the anodes or direct buried lead wires during backfill procedures.

### 3.18 BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING

#### A. Bedding of Pipe

- 1. The trench base shall be undercut a minimum of 6-inches below the bottom of the pipe and uniformly backfilled with bedding material to 6-inches above the pipe.
- 2. Pipe shall be installed on top of the first layer of bedding material and the pipe shall be backfilled with bedding material up to the "spring-line" (halfway) on the pipe. The bedding material shall be "shovel-sliced" or hand tamped around and under the haunches of the pipe to assure adequate and uniform support along the bottom of the pipe.
- 3. Care shall be taken in placing backfill over the crown of the pipe to avoid damage to the pipe. Care shall be taken to prevent dislodging and misalignment of the pipe and to provide adequate bell hole for the pipe.
- 4. All water service lines shall be installed with bedding material from 2-inches below the pipe to 2-inches above the top of the pipe.

#### B. Initial Backfilling of Pipe Trench

- 1. Above the bedding area the pipe shall be backfilled with acceptable native material (Class I, II, and III as described in C605), approved by the Engineer of Record and compacted to 95-percent Standard Proctor Density to 12-inches above the top of the pipe bedding.
- 2. If unacceptable initial backfill material is not found onsite, Contractor shall furnish and install import engineered fill or clay material in the initial backfilling area. Imported material shall be placed in a minimum of two (2) lifts and compacted to a minimum of 95-percent Standard Proctor Density to 12-inches above the top of the pipe bedding.

3. The initial backfill shall be placed evenly so as not to disturb the grade or line of the pipe.
4. Stones larger than 3 inches in diameter shall not be placed within initial backfill of the pipe trench. Care shall be taken in placing backfill over the pipe to avoid damage to the pipe.
5. Native material for all initial backfilling of the pipe trench shall be free of debris, frozen material, large clods or stone, organic matter or other unstable material. Stones larger than 3-inch in diameter shall not be placed within the initial backfill area.

C. Final Backfilling of Trench to Grade

1. All final backfill material shall consist of acceptable native excavation material, approved by the Engineer of Record, and shall be placed in maximum 12-inch lifts and compacted by suitable and approved compaction methods in a manner to achieve at least 95-percent Standard Proctor Density, or as otherwise specified.
2. If unacceptable final backfill material is encountered in the trench excavations, it shall be replaced with other suitable material available at the project site, imported engineered fill, imported clay material or with other suitable imported material, as approved by the Engineer of Record.
3. At least 12-inches of cover shall be placed over the top of the pipe before the trench is wheel-loaded, and 48-inches of cover shall be placed over the top of the pipe before the trench is hydro-hammered for compaction.
4. Material for all areas of backfilling is to be free of debris, frozen material, large clods or stone, organic matter or other unstable material.
5. In final backfill areas below pavement, the Engineer may direct the Contractor to use native material a specified distance below the pavement elevation to ensure a consistent material is utilized under the pavement section.
6. Excess material not required for final backfilling shall be removed by the Contractor or otherwise disposed of as directed by the Engineer.

D. Road Surfacing Base Material

1. Material used under concrete and asphalt surfacing shall meet the requirements as indicated in the Products section of these specifications for "AGGREGATE BASE MATERIAL".
2. Base material shall be placed in maximum 6-inch lifts and compacted by suitable and approved compaction methods in a manner to achieve at least 97-percent Standard Proctor Density, or as otherwise specified.

E. Compaction Testing Requirements

1. All bedding and backfill areas shall be subject to compaction testing by nuclear or standard methods according to the latest applicable ASTM Specifications.
2. Frequency of compaction tests shall be completed in accordance with South Dakota Department of Transportation (SDDOT) Standard Specifications for Roads and Bridges, current edition.

3. The areas requiring compaction testing shall include the bedding, initial backfill, final backfill, road surface base and gravel surfacing material, as defined in the previous sections.
4. The Engineer of Record may require random compaction tests of the material. If any of these tests indicate that the material has not been compacted to the required density, the Contractor shall re-compact said material at no additional cost to the Owner, and the Engineer of Record shall then have the right to take additional compaction tests to assure that this material is compacted to the proper density without any additional cost to the Owner.

### 3.19 UNDERGROUND INTERFERENCE

- A. The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies and BMU, but this does not relieve the Contractor of the responsibility of contacting SD ONE CALL and determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables, or structures which will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the Owners of the structure involved and the Engineer of Record.
- B. When necessary, the Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.
- C. Portions of utilities which are found to interfere with the alignment and grade of the water main will be relocated, altered, or reconstructed by the Owners, or the Engineer of Record may direct changes in the work to avoid interference.
- D. Temporary or permanent relocation or alteration of utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where utility relocation or reconstruction is impractical, the Engineer of Record may order a deviation from alignment and grade.

### 3.20 WATER MAIN AND SANITARY SEWER MAIN SEPARATION

- A. Horizontal Pipe Separation
  1. Water main shall be laid at least 10-feet horizontally from any existing or proposed sanitary sewer mains. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, BMU may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the water main closer to a sanitary sewer main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sanitary sewer main with the bottom of the water main 18-inch above the top of the sanitary sewer.
- B. Vertical Pipe Separation for Sanitary Sewer Crossings

1. The vertical separation between the water main and sanitary sewer main shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the sanitary sewer main to the outside of the water main. This shall be the case where the water is either above or below the sanitary sewer with preference to the water main located above the sanitary sewer.
2. The crossing shall be constructed so that a full length water main pipe be used and the pipe joints will be equidistant and as far as possible from the sanitary sewer main.
3. In the event 18-inches of vertical pipe separation cannot be maintained, adhere to one of the following:
  - a. Use vertical bends to lower the water main under the sanitary sewer main.
  - b. Install an encasement pipe around the water main. The encasement pipe shall be 20-foot minimum in length, centered where the pipes intersect, and sealed at both ends with end seals.

### 3.21 WATER MAIN AND STORM SEWER SEPARATION

#### A. Horizontal Pipe Separation

1. Water main shall be laid at least 10-feet horizontally from any existing or proposed storm sewer mains. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, BMU may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the water main closer to a storm sewer main, provided reinforced concrete pipe (RCP) storm sewer pipe be assembled with either:
  - a. A gasket that conforms to ASTM C443 specifications (generally available for round RCP pipe up to 72-inches), OR:
  - b. A watertight sealant meeting ASTM C990, AASHTO M 198, and Federal Specification #SS-S-210-A.

#### B. Vertical Pipe Separation for Storm Sewer Crossings

1. The vertical separation between the water main and storm sewer main shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the storm sewer main to the outside of the water main.
2. The minimum vertical separation of the water and the storm sewer is dependent on the size of the storm sewer pipe. Larger diameter storm sewer pipes have a greater minimum clearance to prevent water mains from freezing.
3. In the event that vertical pipe separation cannot be maintained, adhere to one of the following:
  - a. Use vertical bends to lower the water main under the storm sewer main and install rigid insulation between the storm sewer and water main.
  - b. Install an encasement pipe around the water main. The encasement pipe shall be 20-foot minimum in length, centered where the pipes intersect,

and sealed at both ends with end seals and install rigid insulation between the storm sewer and water main.

### 3.22 WATER SERVICES

- A. Water services, corporation stops and curb stops for house connections, multiple dwellings, and commercial connections shall be installed as shown on the project drawings or as directed by the Engineer of Record.
- B. Water service pipe shall be bedded in accordance with the requirements of "BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING".
- C. For new construction, splices on the water service will not be allowed from the corporation to the curb stop, and from the curb stop to the meter for new construction. Splice locations for rehab or water service replacement shall be prior approved by BMU Inspector.
- D. All water services shall be installed with tracer wire from the water main to the curb stop box and from the curb stop box to the structure.
  - 1. Contractor shall provide a loop or slack in the tracer wire at each proposed water service. The loop shall be configured to allow for excess tracer wire to be used to connect the water service tracer wire to the tracer wire installed with the water main.
  - 2. Contractor shall splice the water service tracer wire to the main line by using a moisture displacement connector kit.
  - 3. Tracer wire shall be terminated on the curb stop box lid from both the main line and the wire extending to the structure.
  - 4. Tracer wire shall be terminated immediately adjacent to the structure foundation with a grounding rod and associated connectors.
  - 5. BMU shall verify the installation of the tracer wire by energizing and locate the water service via the tracer wire prior to backfilling of the water service.
- E. All curb stops that are installed without a valve box shall be marked to help locate them and prevent breakage when excavating.
  - 1. Water services shall be marked by a vertical section of PVC pipe or an approved marker. The PVC pipe shall be painted blue on the top 1-foot portion of the marker.
  - 2. The marker should be placed near the curb stop or at the termination point of the water service stub-in.
  - 3. The water service marker shall remain in place and be maintained by the Developer or Property Owner until the water service is extended into the property to serve a house, building, or other structure.
- F. Contractor shall coordinate with BMU to installed service connections or disconnections with BMU crews. Water service connections or taps to new or existing water main will not be permitted until the water main has passed the necessary pressure testing and disinfection requirements. All service taps/saddles must be adequately supported prior to backfilling.

- G. Water saddle and taps shall be installed by BMU, using a service saddle and located at 10 o'clock or 2 o'clock on the circumference of the pipe. If cover over a service line is shallow and frost may become a factor, corporations may be installed at 3 o'clock or 9 o'clock on the water main to get additional cover over the water service.
- H. Service connections or disconnects are made using one of the following methods, unless otherwise specified:
  - 1. The Contractor shall excavate a trench to allow BMU crews to install saddles and connect (tap) the water main with a water service corporation stop. The trench shall then be backfilled by the Contractor.
  - 2. The Contractor shall excavate a trench and disconnect the water service at the water corporation stop in the presence of BMU personnel. The trench shall then be backfilled by the Contractor.
- I. The trench for the water service taps shall be excavated to meet all applicable OSHA trench safety requirements prior to any work to be completed by BMU personnel. If the trench is unsafe to complete water service tapping operations, the Contractor shall be required to provide the necessary additional work to ensure safety of the trench to the satisfaction of the BMU tapping personnel.
- J. Curb stops shall be located on, or within 12-inches either side of the property line. Curb stops not installed at the property line, shall be removed and relocated at no expense to BMU.
  - 1. Curb stops installed short of the property line shall be relocated to the property line by removing the entire water service back to the corporation stop and reinstalled to prevent the installation of a splice on the water service.
  - 2. Curb stops installed long of the property line shall be relocated by isolating the water service and cutting the water service back to the property line.
- K. Curb stop boxes which are installed where there is concrete or asphalt surfacing will require a 4-inch PVC casing furnished and installed by the Contractor. 4-inch PVC curb box casing shall be ASTM D3034 with an SDR 35 rating, and shall be cut longer than the concrete or asphalt topping thickness.

### 3.23 CASING PIPE VIA BORING (JACKING)

- A. It shall be the responsibility of the Contractor to maintain the alignment and grade specified. The boring (jacking) specifications shall be in accordance with these specifications, plan sheets, plan notes and Standard Plates.

### 3.24 TEMPORARY WATER MAIN BYPASS SYSTEM

- A. A minimum of 1-weeks prior to operation of the water bypass system, the Contractor shall submit a water main layout and sequence of operations for the temporary water main bypass system for BMU Engineer approval. The BMU Engineer shall be given written notice, at least 2-days in advance, of intent to commence water bypass operations.

- B. The Contractor shall provide a 24-hour contact person who has adequate parts and equipment readily accessible to make necessary repairs to temporary water bypass system or temporary water service in a timely manner.
- C. The Contractor shall notify BMU staff at least 24-hours prior to the planned outage. The Contractor shall inform BMU staff of the estimated time that the water service will be disrupted. BMU shall coordinate with all property Customers for the planned disruption of water service or accessibility issues created by the temporary water main bypass system.
- D. The BMU shall contact customers (that are at the property at the time of service interruption) along the water main project where the customers will have a disruption of water service.
- E. BMU shall furnish and install door hangers on each affected property Customers door. The door hanger shall indicate the time when the property will not have water service.
- F. Bypass piping required for an extended period of time, if directed, shall be buried or covered by granular material ramps where the pipe crosses bike trails, sidewalks, driveways, roads, pedestrian crossings, entrances, etc.
- G. Contractor shall make water service connections either during the day or at other suitable times to minimize the Customers disruption of water service.
- H. Contractor shall provide all chlorinating, testing, pipe, necessary isolation valves, bends, fittings, hydrants, all necessary appurtenances, gravel ramp construction, maintenance and removal, and all other materials and labor necessary to construct the temporary water main and flush each individual service before connection to the BMU water system.
  - 1. Temporary water main is required to be disinfected, flushed, and sampled (Two consecutive coliform bacteria tests shall be taken 24-hours apart) prior to any service connections being made. The temporary water main shall be tested at static main pressure for a period of 2-hours.

### 3.25 SURFACE RESTORATION

- A. The Contractor shall replace all surface material and shall restore paving, curb and gutter, sidewalks, lawn irrigation, fences, trees, sod, topsoil, and other items disturbed to a condition equal to or better before the work began; furnishing all labor, materials, and equipment necessary to do this work. Surface restoration shall conform to all City or DOT right-of-way requirements.

### 3.26 WATER MAIN TESTING SEQUENCE

- A. The following sequencing shall be followed by the Contractor unless an alternative sequencing plan is provided in writing by the Contractor and approved by BMU prior to performing any of the required sampling or pressure testing:
  - 1. Once water main construction is complete, the Contractor shall request to have the pipe segment filled by BMU personnel. Contractor shall make their request during normal business hours, between 8 a.m. to 5 p.m., Monday-Friday. Filling of the pipe segment will be done by BMU at a time determined by the BMU to have minimal impacts to the existing customers.

2. Upon completion of the minimum chlorine contact time, the Contractor shall request to have BMU personnel assist with purging air from line segment.
3. Once air has been purged from the line segment, the line segment shall be hydrostatically tested in accordance with these specifications.
4. The BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test. The BMU representative shall verify that the test hydrant lead valve(s) is in the open position prior to initiating the pressure test.
5. Should the test disclose damaged or defective materials or leakage greater than that permitted, the Contractor shall at his own expense locate and repair and/or replace any defective materials. The test shall be repeated until the leakage is within the permitted allowance.
6. Once a passing hydrostatic test has been obtained, the water main shall be adequately flushed by BMU personnel. BMU will be responsible for disposal of heavily chlorinated water.
7. Once flushing is complete, the line segment shall be bacteriological tested in accordance with these specifications.

### 3.27 HYDROSTATIC TESTING

- A. The Contractor shall furnish all pumping equipment, labor, gauges, and other appurtenances required for the pressure test.
- B. Upon completion of the water main installation, the water main shall be hydrostatically tested using the following guidelines:
  1. For water mains, a pressure of 120 psi shall be maintained for a period of 2-hours. The BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test.
  2. If after 2-hours the pressure has dropped less than 2 psi, the test shall be considered acceptable. If the pressure dropped greater than 2 psi, the volume of water needed to re-pressurize the water main shall be calculated and the Contractor shall be responsible for re-pressurizing the main.
- C. If at any time during the test the pressure drops below the specified test pressure, the Contractor shall re-pressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure. Accurately measure the amount of water required to re-pressurize the system to the initial test pressure.
  1. Maximum allowable leakage rate:  

$$Q = \frac{L D \sqrt{P}}{148,000}$$
 Where:  
 Q = Allowable makeup water, gallons per hour  
 L = Length of pipe section being tested, in feet  
 D = Nominal Diameter of pipe, in inches  
 P = Avg Test Pressure, PSI Gauge  
 ( $\sqrt{120\text{psi}}=10.95$ )

- D. If the average measured leakage per hour exceeds the maximum allowable leakage rate, repair and retest the water main. Repair all visible leaks regardless of the amount of leakage.

### 3.28 DISINFECTION AND BACTERIOLOGICAL TESTING

- A. The Contractor shall place sufficient granular chlorine in the water main as it is installed as required by the most current addition of AWWA C651 disinfection standards. Once water main construction is complete, the Contractor shall request to have the water main segment filled by BMU personnel.
- B. Once the water main is completely filled, the chlorinated water shall remain in the water main for a minimum of 24-hours. Upon completion of the minimum contact time, the Contractor shall request to have the water main flushed by BMU personnel. In order to prevent damage to the pipe lining, heavily chlorinated water shall not remain in contact with the water main for more than 72-hours.
- C. The water main shall be adequately flushed to remove all heavily chlorinated water and remaining particulates. BMU will be responsible for disposal of heavily chlorinated water such that residual levels of chlorine in the discharge water do not exceed 0.05 mg/L when entering the Waters of the State.
- D. One set of bacteria tests is required for every 1,200 lineal feet of water main installed.
- E. Once flushing is complete, BMU personnel will collect a water sample(s) from the water main at an acceptable location for coliform bacteria testing. Contractor shall deliver the water sample(s) to the lab for analysis.
- F. After collection of the first water sample(s), the water shall remain in the water main for an additional 24-hours. After a minimum of 24 hours, BMU personnel will collect a second water sample(s).
- G. Two consecutive passing samples (coliform bacteria absent), at all of the sample location(s), shall be required for a passing bacteria test. Upon receiving notification of the second sample passing, the water main can be put into service and service lines tapped.
- H. If one of the two consecutive coliform bacteria test fails (coliform bacteria present), the Contractor must request that the water main be re-flushed. After the water main is re-flushed, a water sample(s) will be taken and second water sample(s) shall be taken a minimum of 24 hours later than the first re-sample.
- I. If one of the two consecutive re-test samples fails, the Contractor is required to re-chlorinate the water main by the AWWA continuous feed or slug method (liquid chlorine injection through a service tap). The sample testing and retesting protocol established in the previous section will be required until consecutive coliform bacteria test passes.
- J. Contractor shall be responsible for paying, shipping, delivering and/or transporting all samples to the appropriate testing laboratory. Contractor shall provide Engineer of Record and BMU staff a copy of the successful bacterial testing results.

