

**APPENDIX B  
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## SECTION 01525

### TEMPORARY CONSTRUCTION AIDS AND ENVIRONMENTAL CONTROLS

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The Contractor shall furnish temporary utilities, including electricity, lighting, telephone service, water and sanitary facilities; temporary controls, including barriers, protection of work and water control; and construction facilities, including parking, progress cleaning and temporary building as required.

##### **1.02 TEMPORARY UTILITIES**

- A. Temporary Electricity: Contractor shall provide, maintain and pay for all power required by the Contractor, including electrical service to the field office.
- B. Temporary Lighting: Contractor shall provide all temporary lighting required for prosecution of his work and for employee and public safety. As a minimum, lighting levels during working hours shall meet the requirements of UOSHA, subsection 1926.56 illumination.
- C. Telephone Service: Contractor shall provide, maintain and pay for telephone service to the field office.
- D. Temporary Water Service
1. The Contractor shall provide for all workers on the project, an adequate and reasonably convenient, uncontaminated drinking water supply. All facilities shall comply with the regulations of the local and State Department of Health.
  2. Contractor shall be responsible to arrange for water, both potable and non-potable water.
  3. When water is taken from a City water system or any other potable water supply source for construction purposes, suitable precautions shall be taken to prevent cross connection and contamination of the water supply.
- E. Temporary Sanitary Facilities
1. Contractor shall provide and maintain sanitary facilities for his employees and his subcontractors' employees that will comply with the regulations of the local and State Department of Health.

##### **1.03 TEMPORARY CONTROLS**

- A. Barriers: Provide barriers as necessary to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere. Give all unpaved streets, roads, detours, or haul roads used in the construction area an approved dust-preventive treatment or periodically water to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.
- C. Protection of Work: Contractor shall protect installed work and provide special protection where specified in individual specification sections. Contractor shall provide temporary and removable protection for installed products, and shall control activity in immediate work area to minimize damage.
- D. Open Burning: No open burning or waste materials is allowed.
- E. Explosives and Blasting: The use of explosives on the work is not allowed.
- F. Noise Abatement: In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation.
- G. Storm and Ground Water:
  - 1. The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work, whether the water be surface or underground water.
  - 2. In excavation, fill and grading operations, care shall be taken to disturb the pre-existing drainage pattern as little as possible. Particular care shall be taken not to direct drainage water into private property or into streets or drainage ways inadequate for the increased flow.
  - 3. The Contractor shall maintain effective means to minimize the quantity of sediments leaving the work area either by storm water or the Contractor's own dewatering operations.

#### **1.4 CONSTRUCTION UTILITIES**

- A. Parking: Contractor shall provide temporary parking areas to accommodate use of construction personnel. Parking shall be located in an area approved by the Engineer.
- B. Progress Cleaning:
  - 1. Contractor shall maintain areas free of waste materials, debris and rubbish. He shall also maintain the site in a clean and orderly condition. Upon completion of work, repair all damage caused by equipment and leave the project free from rubbish or excess materials of any kind.
  - 2. Thoroughly clean all spilled dirt, gravel or other foreign materials caused by the construction operations from all streets and roads at the conclusion of each day's operation.
  - 3. It shall be the responsibility of the Contractor to promptly clean up and remove any oil and or fuel spills caused by the Contractor or his subcontractors during the course of the project. The Contractor shall properly dispose of contaminated soil according to local and State laws. The Contractor shall be responsible for any damages to the Owner resulting from the Contractor's actions in promptly cleaning up said spills.

## **1.5 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS**

- A. Contractor shall remove temporary above grade or buried utilities, equipment, facilities and materials prior to application for final progress payment. Clean and repair damage caused by installation or use of temporary work. Restore existing facilities used during construction to their original condition.

## **1.6 MEASUREMENT AND PAYMENT**

- A. Temporary utilities and facilities shall not be measured or paid as a separate item but shall be included as part of the various items to which it relates.

\*\*\* END OF SECTION \*\*\*

## SECTION 01554

### TRAFFIC CONTROL

#### **PART 1 – GENERAL**

##### **1.01 SCOPE OF WORK**

- A. General. The work shall consist of establishing traffic control and maintaining safe, convenient use of public roads and rights-of-way.
- B. This section covers Traffic Control Plan requirements and materials and labor necessary for its implementation. It also includes issues related to Traffic Control Maintainer and flagging, work zone traffic control devices, advance warning arrow panels and pilot cars.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 00555 – Prosecution and Progress.
- B. Section 00727 – Scope of Work
- C. Section 00727 – Control of Work.
- D. Section 01558 – Temporary Pavement Markings
- E. Section 02842 – Delineators.
- F. Section 02891 – Traffic Signs.
- G. Section 02765 – Pavement Marking Paint.

##### **1.03 REFERENCES**

- A. AASHTO Roadside Design Guide, current edition.
- B. Manual of Uniform Traffic Control Devices (MUTCD), current edition.
- C. ATSSA: American Traffic Safety Services Association.
  - 1. Quality Standards for Work Zone Traffic Control Devices
- D. NCHRR – Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features.
- E. OSHA Construction Industry Standards (29 CFR Part 1926), Subpart G, Signs, Signals, and Barricades.

##### **1.04 SUBMITTALS**

- A. Submit traffic control plan in accordance with the Special Conditions and UDOT State Specifications. The traffic control concept shown on the plans is for bidding purposes and is intended to serve as a guideline only. The Contractor shall be responsible for the preparation and adequacy of any traffic control plan utilized, including this suggested plan, and shall submit the final traffic control plan (prepared, signed and sealed by a Utah licensed professional engineer) in drawing form to the Engineering inspector.
- B. Submit to the Engineering inspector a detailed signing and traffic detouring plan in drawing form for each phase for approval. Post detour routes to provide clear guidance to traffic as approved by the Engineering inspector.

## **1.05 GENERAL**

- A. Control traffic at those locations indicated and in conformance with the plans approved by the Engineering inspector.
- B. Furnish, install, construct, maintain, and remove detours, road closures, lights, temporary signals, signs, barricades, K-rail, fences, flares, miscellaneous traffic devices, flagmen, drainage facilities, paving, and such other items and services as are necessary to adequately safeguard the public from hazard and inconvenience. All such work shall comply with the ordinances, directives, and regulations of authorities with jurisdiction over the public roads in which the construction takes place and over which detoured traffic is routed by the Contractor.
- C. After devices have been installed, maintain and keep them in good repair and working order until no longer required. Replace such devices that are lost or damaged, to such an extent as to require replacement, regardless of the cause of such loss or damage.
- D. Prior to the start of construction operations, notify the Engineering inspector, South Jordan City, UDOT, police and fire departments in whose jurisdiction the project lies, giving the expected starting date, completion date, and the name and telephone number of a responsible person who may be contacted at any hour in the event of a condition requiring immediate correction.

## **1.06 TRAFFIC CONTROL DEVICES AND SIGNS**

- A. Construction signing, striping, barricades, and other traffic control devices used for handling traffic and public convenience shall conform to the latest edition of the Federal Highway Administration "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD).
- B. Signs shall be reflectorized when they are used during hours of darkness. Provide cones, pylons, barricades, or posts used in the diversion of traffic with flashers or other illumination if in place during hours of darkness.
- C. Maintain a 24-hour emergency service to remove, install, relocate, and maintain warning devices and furnish to the authority having jurisdiction names and telephone numbers of three persons responsible for this emergency service. In the event these persons do not promptly respond or the authority having jurisdiction deems it necessary to call out other forces to accomplish emergency service, the Contractor will be held responsible for the cost of such emergency service.
- D. During the duration of a detour, cover all signs not in accordance with the traffic control plan. Relocate existing signs to provide visibility from all relocated traffic lanes.
- E. Temporary traffic striping, where used, shall be removable pavement marking tape. Pavement markings shall be white or yellow, weather and traffic resistant reflective film on conformable backing and pre-coated with a pressure-sensitive adhesive that does not require an activation process.

Temporary pavement markings shall conform to the following minimum reflective values as specified. Express reflective values as candlepower per foot-candle per square foot measured on a 1 foot by 2 foot panel at 86 degrees incidence.

| Divergence Angle | White | Yellow |
|------------------|-------|--------|
| 0.20             | 0.20  | 0.18   |
| 0.50             | 0.18  | 0.16   |

Supply striping tape in rolls ready for application. Use pavement message tape 20 to 30 mils thick, that does not shrink or release prematurely, and that has an easily removable liner.

- F. At the end of each workday, place temporary pavement markers on any roadway surfaces open to traffic. Apply pavement markers to a clean and dry surface during daylight hours. During winter shutdown, place permanent paint striping and pavement messages.
- G. Press the tape into the surface until it adheres to the pavement surface.

**1.07 VEHICULAR TRAFFIC CONTROL**

- A. Reduce speed limit through the construction zone to 25 mph and post accordingly.
- B. Traffic lane transitions from permanent lanes to construction zone patterns shall be transitioned in accordance with the requirements for the normal posted speed limit and as shown on the plans.
- C. Where traffic is directed around or adjacent to the construction area, the contractor shall provide, lights, signs, and other devices required for the control of traffic as required by the UDOT traffic regulations and said "Manual of Uniform Traffic Control Devices." The engineering inspector shall have the right to relocate or direct the Contractor to relocate traffic control devices.
- D. In the event the Engineering inspector finds the worksite to be improperly barricaded or delineated and the Contractor is either unavailable or unresponsive to requests for improvement, the Engineering inspector will furnish and set up barricades and delineators as required. Two hundred dollars (\$200) will be charged the Contractor for each set-up event plus five dollars (\$5) "rental" for each barricade or delineator for each day's or partial day's use until such barricades or delineators are returned in good condition by Contractor or the Owner's yard.
- E. All roadways and sidewalks shall be returned to unrestricted vehicle and pedestrian usage when construction is not underway.
- F. Truck operations in and out of construction and staging areas shall be controlled by flagmen at all times.
- G. The maximum delay to the public due to Contractor construction activities is four hours.
- H. Construction in Intersections: Maintain at least one through lane in each direction on the following intersecting streets during working hours while constructing within the intersection
- I. Detour Routing: Notify the Engineering inspector at least 2 calendar days in advance and complete coordination prior to the detouring of traffic along the affected streets.

## **1.08 ACCESS TO ADJACENT PROPERTIES**

- A. General: Maintain reasonable access from the project to all adjacent properties at all times during construction. Prior to restricting normal access from public streets to adjacent properties, notify each property owner or responsible person, at least three working days prior to the disruption, informing him of the nature of the access restriction, the approximate duration of the restriction, and the best alternative access route for that particular property.

## **1.09 BIDDING REQUIREMENTS**

- A. The apparent low bidder will:
1. Submit three copies of the Traffic Control Plan to the Engineer no later than the fourth Wednesday following the bid opening. Submit plans in 11x17 format prepared using AutoCAD software. All plans must be signed and sealed by a professional engineer licensed in the State of Utah. When available, the City will provide basemap CAD files to the Contractor on a CD-ROM at no cost.
  2. Attend a mandatory meeting at the time and location as directed by the Engineer with City staff and the following:
    - a. Contractor's traffic control designer
    - b. Contractor's traffic control maintainer
    - c. Resident engineer
    - d. City's Traffic Engineer or designated representative
  3. Ensure compliance with the plans and specifications. Modify plan if necessary to meet all applicable requirements.
  4. The City will grant no additional contract time for preparing or modifying the Traffic Control Plan.
  5. Do not begin work. Do not implement traffic control until written authorization is received from the Engineer.

## **1.10 CERTIFICATIONS**

- A. After April 1, 2002, use devices and systems which meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration. Some exceptions will be acceptable as stated below.
1. Category 1: Cones, tubular marker, delineators, and drums without lights must be certified by the manufacturer as meeting NCHRP-350 Report requirements.
  2. Category 2: portable sign stands with signs, Type I, II, and III barricades, vertical panels, Category 1 devices with light attachments and devices not expected to cause significant vehicle velocity change. These devices and systems must be certified by FHWA as meeting NCHRP-350 Report test requirements.
  3. Category 3: Portable/temporary precast concrete barrier manufactured after October 1, 2002 must be certified as meeting NCHRP-350 Report test requirements.
    - a. Manufactured date to be stamped into top of each barrier section using a numeric format (ex: 10/2002) with 75 mm x 50 mm numerals, 6 mm deep).
    - b. Portable/temporary precast concrete barrier manufactured prior to October 1, 2002 and meeting NCHRP-230 may be used until they are no longer serviceable.
  4. Category 3: Crash cushions and truck mounted attenuators must be certified by FHWA as meeting NCHRP-350 Report test requirements

- a. The appropriate GREAT CZ, manufactured by Energy Absorption Systems, may be used until they have completed their normal service life.
5. Category 4: Advanced warning arrow panels and portable variable message signs do not have to meet NCHRP-350 Report test requirements.

## **1.11 TRAFFIC CONTROL PLAN REQUIREMENTS**

- A. Traffic Control Plan (TCP) Checklist and Guidelines – In preparing the Traffic Control Plan, the design professional will need to address the following items:
1. The Traffic Control Plan (TCP) shall be drawn on 24" x 36" or 11" x 17" sheets, unless otherwise approved by the City's Project Manager. TCPs prepared for work occurring on all streets shown on the Circulation Element of the General Plan shall be prepared by a Registered Civil Engineer or Registered Traffic Engineer.
  2. Draw the TCP with ink using legible lettering and symbols.
  3. Indicate contractor's name, address and telephone number. Include name and telephone number of the 24-hour contact person presenting the Contractor.
  4. Indicate a north arrow and scale on the drawings. If the drawing is NOT-TO-SCALE (N.T.S.), indicate so on the drawing.
  5. Show all nearby streets with street names to assure proper orientation.
  6. Show existing traffic signals and regulatory signs, as appropriate.
  7. Show existing striping, pavement markings, painted crosswalks and bike lanes.
  8. Show existing curbs, gutters, sidewalks, driveways and intersections in the construction work zone including areas affected by taper transition.
  9. Indicate total roadway widths. Dimension existing striping from edges of pavement.
  10. Indicate posted speed limits.
  11. Show location and dimensions of the construction work zone.
  12. Show staging areas and materials storage area, as appropriate.
  13. Indicate locations of construction signs, barricades, and delineators.
  14. Label all taper lengths and widths, delineator spacing and sign spacing.
  15. Use a legend to define all symbols and designate them with UDOT nomenclature.
  16. Show all parking restriction zones and signs, as appropriate.
  17. Road closures will require approval from the City Engineering and the City Council.
  18. Signs and barricades will be required to direct pedestrians through or around the construction work zone and shall be shown on the TCP.
  19. Indicate the encroachment permit number or improvement plans number on the traffic control plan.
  20. Indicate on the plan the duration of the construction work and subsequent traffic control
- B. Traffic Control Plan General Notes – The following notes need to be attached to and adhered to in preparing and implementing the Traffic Control Plan.
1. All traffic control devices shall conform to the latest edition of the UDOT's Traffic Manual of Traffic Control Devices for Construction and Maintenance Work Zones and the Standard Specifications for Public Works Construction.
  2. The City Engineer or his representative has the authority to initiate field changes to assure public safety.
  3. All traffic control devices shall be removed from view when not in use.
  4. Work hours shall be restricted to between 7:00 a.m. and 10:00 p.m. unless otherwise approved.
  5. Trenches must be back filled or plated during non-working hours.

6. Pedestrian controls shall be provided as shown on the plans.
  7. Temporary "NO PARKING" signs will be posted 24-hours prior to commencing work.
  8. Access to driveways will be maintained at all times unless other arrangements are made.
  9. The Contractor shall replace all traffic signal loop detectors damaged during construction within 72-hours of them being damaged.
  10. All striping removed or damaged, will be replaced by the Contractor within 24-hours (or replaced with temporary tape).
  11. All Workers shall be equipped with an orange vest (or a reflective vest at night). All flaggers shall also be equipped with a hard hat, C28 "Stop/Slow" paddle, shall be trained in the property fundamentals of flagging traffic, and be certified as indicated in this section
  12. Any work that disturbs normal traffic signal operations shall be coordinated with the City of West Jordan's Traffic Engineer, 48-hours prior to beginning construction.
  13. The Contractor shall maintain all traffic control devices 24-hours per day and 7-days per week.
  14. A minimum of twelve (12) foot travel lanes must be maintained unless otherwise approved by the Engineering Department.
  15. All night work will require written approval from the Engineering Department. Lane closures, road detours, road closures, and traffic signal modifications associated with overnight construction activities will require warning signs be placed at least one week in advance of starting construction
  16. A solar powered flashing arrow board shall be required on all arterial street land closures.
- C. Design the traffic control plan resolving discrepancies between the various standards for traffic control in accordance with Section 00727 – Control of Work paragraph 1.5.B and the following:
1. UDOT Standard Traffic Control Drawings 745-2 Series. UDOT Standards Drawing 745-60, 745-60A, 745-60B, and 745-60D for post mounted signs.
  2. Manual of Uniform Traffic Control Devices (MUTCD), latest edition.
- D. Follow the requirements and limitations identified in the Traffic Control Special Provision (if included), Section 00555, Prosecution and Progress, paragraph 1.11. Limitation of Operations, Section 00725, Scope of Work, paragraphs associated with the maintaining of traffic and Section 00820 – Legal Relations and Responsibility to Public, paragraph 1.10 "Public Convenience and Safety – Traffic and Pedestrians".
- E. Consider the safe and efficient movement of traffic when land closures are proposed.
1. Open lanes to traffic wherever and whenever practical.
  2. Minimize and restrict land closures to the locations and times essential for prosecution of work.
- F. Provide for concrete barriers and attenuation to satisfy hazard mitigation according to UDOT Standard Drawing 745-2 Detail AA, and 745-2E Detail E-1.
- G. Provide for delineation and temporary pavement markings and/or removal as needed for traffic control or as required in accordance with this section, paragraph 1.6, lines H and I.
- H. Provide protection for all hazards (i.e.: bridge parapets, barrier blunt ends, poles, large equipment to include but not limited to cranes, pile drivers, etc.) when hazard is within AASHTO clear zone requirements for approach traffic.

- I. Use the following format and provide the following documentation:
  1. Section I: Description of each phase
    - a. List phases, and corresponding bid items and elements of work to be accomplished in each phase.
    - b. Accounting for each contract bid item and element of work, reference the traffic control detail designed to provide for the safe and efficient movement of traffic and safety of workers.
    - c. All contract bid items and elements of work must be identified and included in the phasing.
  2. Section II: CAD generated drawings showing detailed Traffic Control Plan for each phase:
    - a. Adapt Standard Drawings and work zone traffic control examples contained in the MUTCD to reflect actual project conditions such as curves, grades, presence of ramps, intersections and accesses.
    - b. Use basemap CAD files when supplied by the City as a basis for the Traffic Control Plan drawings.
    - c. Use the same level of detail as in the MUTCD and UDOT Standard Traffic Control Drawings.
    - d. Include the anticipated duration of the traffic control setup used in each phase.
    - e. Provide for the safe passage of pedestrians and bicyclists through the work zone in accordance with the Americans with Disabilities Act and the MUTCD.
    - f. Indicate clearly, the following:
      - i. Proposed regulatory speed reductions in accordance with this Section, paragraph 3.6.
      - ii. For all tapers; length of taper, device spacing, land or shoulder closures, amount of land shift in accordance with this Section, paragraph 3.3.A.
      - iii. Length of buffer zone, in accordance with this Section, paragraph 3.3.A.
      - iv. Device spacing used in tangents in accordance with this Section, paragraph 3.3.B.
      - v. Lengths of work zones, land and shoulder widths and area available for vehicle recovery.
      - vi. Proposed changes to be made to existing traffic signals including: timing changes, phase changes, etc.
      - vii. Sign locations for required and existing signs.
      - viii. Existing signs that are to be removed, covered, relocated or otherwise changed from the original configuration.
      - ix. Worker parking, work vehicle and equipment access to and from work area, staging and material sites.
  3. Section III: Emergency and Special Situations
    - a. Identify procedures for dealing with emergencies and special situations.
- J. Provide temporary pavement markings on newly constructed asphalt pavement and refresh as needed until the final surfacing is placed in accordance with Section 01558: Temporary Pavement Markings, as directed by the Engineer.
- K. Completely remove all existing traffic marking that conflict with the Traffic Control Plan, in accordance with Section 02765. Do not use paint or other material to cover markings.

## **1.12 TRAFFIC CONTROL MAINTAINER**

- A. Certified by the City or by the American Traffic Safety Services Association (ATSSA) as a Traffic Control Technician. Certifications are available through:

1. Associated General Contractors  
1135 South West Temple  
Salt Lake City, Utah  
Telephone: (801) 363-2753
2. American Traffic Safety Services Association (ATSSA)  
15 Riverside Parkway, Suite 100  
Fredericksburg, Virginia 22406-1022  
Telephone: (800) 272-8772  
Internet: www.atssa.com

B. Authority:

1. Obtains and uses all labor, equipment, and materials necessary to maintain traffic control.
2. Changes traffic control operations per the traffic control plan.

C. Responsibility and Duties:

1. Oversees all traffic control operations.
2. Implement the Traffic Control Plan.
3. Remains available 24-hours a day, 7-days a week and can be on-site within 30-minutes of notification.
4. Corrects deficiencies immediately upon verbal or written notification from the Engineer or representative.
5. Inspect and document inspections of traffic control on a from acceptable to the Engineer at least four times each day as follows:
  - a. Before beginning of shift.
  - b. At mid-shift.
  - c. Half-hour after evening shift ends.
  - d. At the midpoint of the off-shift period.
6. Coordinates project traffic control with emergency services and local law enforcement agencies.
7. Inspect and document inspections of traffic control twice each day when no construction work is being done.
  - a. One during light hours and one during nighttime hours.
  - b. Conduct inspections a minimum of 8-hours apart.
8. Completes a daily record of traffic control activities using a form acceptable to the Engineer.
9. Submit to the Engineer, inspection and activities forms each week on a day and time acceptable to the Engineer.
10. Provide a daily report of all planned traffic control activities to the Engineer by 7:00 AM each day. Provide the report each day during the contract.

### **1.13 TRAFFIC AND ACCESS**

- A. The Contractor's operations shall not cause unnecessary inconvenience to the public. The public right-of-way shall be maintained at all times unless the City authorizes interruption. The Contractor's desire to close and/or detour traffic is to be authorized through the preparation of the required plans, which will then be approved by the City's Traffic Engineer or authorized representative.

- B. Safe and adequate access shall be provided and maintained to all public protection devices and to all critical utility locations. Facility access shall be continuous and unobstructed unless otherwise approved by the City's Traffic Engineer.

#### **1.14 STORAGE OF EQUIPMENT AND MATERIALS IN PUBLIC STREETS AND RIGHTS-OF-WAY**

- A. Construction materials and equipment shall not be stored or parked on public streets, roads, or highways. During any material or equipment loading and/or unloading activities that may temporarily interfere with traffic, acceptable detour(s) will be provided for the duration of the activity. Any associated expense for this activity will be the responsibility of the Contractor.
- B. Excavated material, including suitable material that is intended for adjacent trench backfills or other earth backfill as specified in Section 5 of this specification, shall not be stored in the public streets, roads, or highways that remain in service for the public. Any waiver of this requirement must be obtained from the proper local authority and approved by the Engineer. All excess and unsuitable material shall be removed from the site as soon as possible. Any spillage shall be removed from roadways prior to use by the public.

#### **1.15 STREET CLOSURES, DETOURS, AND BARRICADES**

- A. The Contractor shall comply with the requirements of all applicable responsible units of government for closure of any street, road, or highway. The Contractor shall provide the required barriers, guards, lights, signs, temporary bridges, and flaggers together with informing the public of any detours and construction hazards by the most suitable means available such as local newspapers, local radio stations, etc. The Contractor shall also be responsible for compliance with additional public safety requirements that may arise during construction. The Contractor shall furnish and install, and upon completion of the work, promptly remove all signs, warning devices, and other materials used in the performance of this work.
- B. Unless otherwise specified, not less than seven (7) days prior to closing, or partially closing, or reopening any street, road, or highway, the Contractor shall notify in writing, the Fire Chief, Police Chief, County Sheriff, State Highway Patrol, schools that operated school buses, or any other government official as may be appropriate.
- C. Unless otherwise specified, the Contractor shall furnish to the Engineer a written plan showing the proposed method of signing, barricading for traffic control, and safety for the street detours and closures.
- D. All temporary detours will be maintained to ensure use of public rights-of-way is provided in a safe manner. This may include dust control, grading, graveling, etc., as required by the City's project manager and this specification.

#### **1.16 MAINTENANCE OF WORK ZONE TRAFFIC CONTROL**

- A. Implement and maintain traffic control per the Traffic Control Plan. Implement changes to traffic control required in order to meet UDOT Standard Specifications. Drawings and MUTCD at no additional cost to the City. Coordinate changes to traffic control and the Traffic Control Plan with

the Engineer prior to implementation.

- B. Meet all requirements of this Section, paragraph 1.7 when traffic control devices are required to be in place overnight or on weekends.
- C. Meet the acceptable classification as identified by *Quality Standards for Work Zone Traffic Control Devices* published by American Traffic Safety Services Association (ATSSA) for traffic control devices.
  - 1. Wash devices weekly unless conditions warrant more frequent cleaning.
- D. Maintain traffic control devices during and after all snow plowing operations at no additional cost to the City. Clear snow away from all traffic control devices so that the devices function as intended.

#### **1.17 WAGE RATES FOR TRAFFIC CONTROL PERSONNEL (Federal Aid Jobs Only)**

- A. Payment of wages must be as stated below during the time the certified Traffic Control Maintainer, or others involved in setting up or maintaining traffic control devices working under the direction of the certified Traffic Control Maintainer, is on the project site and does any of the following work:
  - 1. Laborer I – for moving traffic control devices by hand: loading or unloading devices on to or off of the truck: and for all hours required to be at the project site except those hours spent in the truck driver classification.
  - 2. Truck Driver – for all hours spent driving on the project site in the performance of the duties required to maintain the traffic control. The rate of pay is determined by the size of vehicle being driven. Pickup Truck being the smallest.

#### **1.18 MEASUREMENT AND PAYMENT**

- A. For items of work for which specific lump sum prices are established in the contract, payment for the work will be made at the contract lump sum price. Progress payments will be made based upon the percentage of estimated total time that traffic control will be required unless otherwise specified in Section 7 of this specification. Payment will constitute full compensation for all flaggers, labor, materials, equipment and all other items necessary and incidental to completion of the work.
- B. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in Section 7 of this specification.
- C. Partial Payments – Based on the percentage of the project completed, excluding the cost of traffic control.
- D. Price Adjustments:
  - 1. The City reduces payment when traffic control is not in compliance with the Traffic Control Plan, or when the contractor fails to meet all requirements cited or referenced in this specification.
    - a. The amount per day by which the Contractor's compensation will be reduced is calculated using the daily charge for Calendar Day in the Schedule of Liquidated Damages in Table 1 of Section 00555 or the Contract lump sum bid price for Traffic Control divided by the number of contract days, whichever is greater.
  - 2. A Stop Work Order issued due to non-compliance with this specification is not considered to be

an authorized suspension of contract time. Contract time will continue to accrue as defined in Section 00555, paragraph 1.14 – “Determining Contract Time”.

- E. Include in the bid item “Traffic Control” all materials, equipment, labor, flagging, pilot car, temporary pavement markings and/or removal and workmanship required for the design, implementation and maintenance of the Traffic Control Plan.
- F. Provide the Engineer in writing with a detailed analysis showing impacts to traffic control caused by extra work that necessitates modifications to the Traffic Control Plan. Negotiate and agree to either a lump sum price for additional Traffic Control or agree to unit prices to be used for additional traffic control measures or devices required, prior to performing the extra work.

## **PART 2 -- PRODUCTS**

### **2.01 PILOT CAR**

- A. Equip with a reflectorized sign:
  - 1. Comply with Section 02891: Traffic Signs.
  - 2. MUTCD sign G20-4
- B. Equip with a minimum two rotating lights or strobe lights.
  - 1. Minimum 100-mm diameter and minimum 1830 mm mounting height
  - 2. Yellow color

### **2.02 FLAGGER EQUIPMENT AND CLOTHING**

- A. Comply with UDOT’s “Flagger Training Handbook”.
- B. Comply with Standard Drawings 745-1.
- C. Clothing:
  - 1. Flagger vest and hard hat: Orange, red-orange, or fluorescent version of these colors with:
    - a. Minimum 83870 mm<sup>2</sup> each on the front and back of strong yellow-green reflective tape, or
    - b. Minimum of 41935 mm<sup>2</sup> each on the front and back of strong yellow-green non-reflective tape, with 41935 mm<sup>2</sup> white reflective tape placed on both sides of the non-reflective tape on the front and back.
    - c. Orange or fluorescent orange hardhat with 6450 mm<sup>2</sup> of white or strong yellow-green reflective tape placed around the base of the hard had and visible to traffic.

### **2.03 TRAFFIC CONTROL SIGNING AND DEVICES**

- A. Signs:
  - 1. Comply with paragraph 1.5.
  - 2. Comply with Section 02891 – Traffic Signs.
  - 3. Comply with Standard Drawing 745-1.
  - 4. Comply with Standard Drawings 745-60, 745-60A, 745-60B, and 745-60D when using post mounted signs.

B. Channelizing Devices:

1. Comply with paragraph 1.5.
2. Comply with Standard Drawing 745-1.
  - a. Comply with Section 02891, paragraph 2.1.E. – Reflective Sheeting.
  - b. Use construction orange tubular markers and cone during daylight hours only.

C. Precast Concrete Barrier:

1. Comply with paragraph 1.5.
2. Comply with UDOT Standard Drawings 745-2, Detail AA, and 745-2E, Detail E-1.
3. Use an approved construction zone attenuator or permanent style end sections, as listed in UDOT Guidelines for Attenuators and End Section.
  - a. Use a construction zone attenuator when approach ends of temporary precast barrier are within AASHTO clear zone.
    - i. Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements.
    - ii. Install attenuators or end sections as per UDOT Standard Drawings 735-1 series and manufacturers recommendations.
4. Do not use a truck-mounted attenuator (TMA) to protect temporary precast barrier end for more than 24-hours. Use properly rated TMA as directed in this Section, paragraph 2.3.D.

D. Use properly rated truck-mounted attenuator for the posted speed limit prior to construction.

1. NCHRP-350 Test Level 2 for speeds 45 mph or less.
2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.

## **2.04 ADVANCE WARNING ARROW PANEL**

A. Advance Warning Device:

1. Meet all standards as specified in the MUTCD, Section 6F.53 – Arrow Panels.
2. Perform all functions as specified in UDOT Standard Drawing 745-1 and the MUTCD.

## **PART 3 -- EXECUTION**

### **3.01 MODIFICATION OF TRAFFIC CONTROL PLANS**

- A. Each phase of construction must use an authorized Traffic Control Plan. If a construction phase is proposed that is not covered by the Traffic Control Plan, submit a proposed plan to the Engineer for review.
1. Submit proposed plans to the Engineer 10 working days before the Traffic Control Plan is to be implemented.
  2. Do not begin work until the new Traffic Control Plan is authorized for use and has been fully implemented.
  3. Implement changes required to meet UDOT Standard Specifications, Standard Drawings and MUTCD at no additional cost to the City.
    - a. Comply with this Section, paragraph 1.4.A.1.

### **3.02 FLAGGING**

- A. Flaggers must have a current flagging certificate and must present proof of certification upon request by the City.
  - 1. Acceptable certifications
    - a. UDOT Contractor Certification (Utah Valley State College).
    - b. American Traffic Safety Service Association (ATSSA).

### **3.03 TRAFFIC CONTROL SIGNING AND DEVICES**

- A. Use posted speed limit prior to construction to compute sign spacing, taper lengths, buffer zones and construction clear zone.
  - 1. Use plastic drums for land closure taper devices for speeds 50 mph and greater.
  - 2. Do not use cone or tubular markers at night.
- B. Use posted speed during construction to compute the tangent spacing for channelizing devices.
- C. Remove all traffic control from site of work when not required within 24-hours.
  - 1. Remove traffic control devices from the roadway a distance twice that of the Construction Clear Zone (Table 1 – Standard Drawing TC 2A) if they will be used within 24-hours of the daily work stoppage and are not required for immediate traffic control.
    - a. Obtain written permission from property owner prior to storing traffic control devices on private property.
  - 2. Cover post mounted signs when directed by Engineer.
    - a. Cover signs completely with an opaque and durable covering.

### **3.04 ADVANCE WARNING ARROW PANEL**

- A. May substitute Type C units for Type B units.
  - 1. Comply with UDOT Standard Drawing 745-1.
- B. Do not substitute Type B units for Type C units.
- C. Remove Advance Warning Arrow Panel from the site of work when not needed for the control of traffic within a 4-hour period.

### **3.05 TRAFFIC SIGNALS**

- A. Use uniformed police officers when construction activities are impacting an operating signalized intersection.
- B. Use of flaggers at traffic signals is permitted when the signals have been turned to red flash mode.
  - 1. Each approach is to be controlled by a separate flagger(s).
    - a. Flaggers can control only two lanes of approach traffic.
      - i. Third land control permitted when left or right turn bays are present.
- C. Changes to traffic signal operations will be done by the City.

### **3.06 CONSTRUCTION ZONE SPEED LIMIT REQUIREMENTS**

- A. Obtain approval from the Engineer for regulatory speed reductions.
  - 1. See Standard Drawing 745-2, General Note 9.
  - 2. Use speed reduction only when construction activities impact traffic.
  - 3. Restore regulatory speed limit at locations where construction activities are not impacting traffic.
  - 4. See Standard Drawing 745-60, 745-60A, 745-60B, 745-60D for post-mounted sign requirements.

\*\*\* END OF SECTION \*\*\*

## SECTION 02112

### CLEARING, GRUBBING, AND STRIPPING

#### **PART 1 – GENERAL**

##### **1.01 SCOPE OF WORK**

- A. This section describes the work included in clearing, grubbing, stripping and preparing the project site for construction operations.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02200 - Earthwork
- B. Section 02222 - Protecting Existing Underground Utilities
- C. Section 02223 - Trenching, Backfilling and Compacting
- D. Section 02900 - Revegetation Plan
- E. State of Utah, Department of Environmental Quality, Division of Solid and Hazardous Waste, Solid Waste Permitting and Management Rules, R315-301 Through 320

##### **1.03 CLEARING**

- A. Remove and dispose of only those trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth not shown to be protected which are necessary for construction of the project. Remove all evidence of their presence from the surface including sticks and branches greater than 1-inch in diameter or thickness. Remove and dispose of trash piles, and rubbish, and fencing. Protect structures and piping above and belowground, trees, shrubs, and vegetative growth and fencing which are not designated for removal.
- B. Preserve and protect the existing vegetation not required, or otherwise authorized, to be removed. Vegetation specifically shown on the drawings to be protected shall be protected from damage or injury caused by Contractor's construction operations, personnel, or equipment by the use of protective barriers or other methods approved by the Engineering inspector. Removal of existing vegetation within the designated R/W not specially required to be removed will require approval of the Engineering inspector.
- C. Trees shall not be used for anchorages. If tree climbing is necessary, safety ropes shall be used, and the use of climbing spurs will not be permitted.
- D. The Contractor shall be responsible for injuries to vegetation caused by Contractor's operations, personnel, or equipment. The term "injury" shall include, without exceptions, bruising, scarring, treating, and breaking of roots, trunks, or branches. Injured vegetation shall be repaired or treated without delay. Repairs or treatment shall be as recommended by and under the direction of, an experienced horticulturist or licensed tree surgeon provided by the Contractor and approved by the Engineering inspector. If vegetation cannot be treated or repaired, the Contractor will be responsible for replacing the damaged vegetation. The Engineering inspector must approve replacement vegetation. No noxious or non-native vegetation shall be planted or introduced into the construction areas.

## **1.04 GRUBBING**

- A. After clearing, remove and dispose of wood or root matter, including stumps, trunks, roots, or root systems greater than 1-inch in diameter or thickness to a depth of 12-inches below the ground surface. Options available for disposal include burning (with appropriate permits and approvals), gathering and hauling material to an approved disposal site, or chipping and shredding the material according to City standards and mixing it with the topsoil. Further discussions of this item are included in the Land Disturbance Design and Construction Standards, Section 2.2.

## **1.05 TOPSOIL**

- A. Existing soil material containing sod, grass, or other vegetation and topsoil shall be removed to the existing topsoil depth or 12-inches, whichever is less, from all construction areas except existing pavement and slopes steeper than 1:1.
1. Strip, segregate, and stockpile existing topsoil from the following areas:
    - a. Wetland areas
    - b. Pipeline excavations and stockpile areas
    - c. Road excavations
    - d. All staging, service, and storage areas
  2. Stripping shall be to the existing topsoil depth or 12-inches, whichever is less. All suitable topsoil materials, which are stripped, shall be used in accordance with the contract documents and may be placed directly or else shall be stockpiled in areas designated by the Engineering inspector. Topsoil stripped from wetland areas and areas known to be occupied by endangered plant species will be stockpiled in separate areas designated by the Engineering inspector and will be respread in the wetland and habitat areas from which they were removed to the depth of 12-inches.
  3. Topsoil that has been stripped shall be placed at an approximate thickness of 6-inches or as directed by the Engineering inspector, on all other areas which have been excavated or otherwise disturbed by construction activities except slopes greater than 1:1 unless otherwise instructed by the Engineering inspector. Areas to receive topsoil are as follows:
    - a. Roadway excavation and embankment slopes
    - b. Pipeline alignment
    - c. Disturbed areas within staging, service and storage areas
    - d. Other areas as directed by the Engineering inspector
    - e. Disturbed Ute ladies-tresses habitat and wetlands areas shall receive topsoil removed from the original habitat, as described in 1.05.B.2 above.
  4. Topsoil, which cannot be placed directly in the final location, shall be stockpiled temporarily in designated areas and later placed in the final location as directed by the Engineering inspector. The area over which topsoil is to be placed shall be clean of debris. The surface shall generally conform to smooth lines, slopes, and grades so that adequate control of thickness of topsoil placed can be maintained.

## **PART 2 -- PRODUCTS**

### **2.01 TREES AND SHRUBBERY**

- A. Existing trees, shrubbery, and other vegetative material may not be shown in the Contract

Documents. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve in place, trees that are specifically shown in the drawings and designated to be preserved.

## **2.02 PRESERVATION OF TREES, SHRUBS, AND OTHER PLANT MATERIAL**

- A. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
- B. When trees are close together, restrict entry to area within drip line by fencing. In areas where no fence is erected, protect the trunks of trees 2 inches or greater in diameter by encircling the trunk entirely with boards held securely by 12-gage wire and staples. This protection shall extend from ground level to a height of 6 feet. Cut and remove three branches where those required to affect the work to provide balanced appearances of any tree. Treat cuts with a tree sealant.

## **PART 3 -- EXECUTION**

### **3.01 CLEARING AND GRUBBING LIMITS**

- A. Prior to actual, in-the-field clearing and grubbing efforts, the Contractor shall have a licensed land surveyor survey the clearing and grubbing limits for the project and mark the limits clearly. Once the surveying has been completed, the Contractor shall then install the silt fence prior to the main effort of clearing and grubbing the project. Clear and grub excavation and embankment areas associated with new structures, slabs, and roadways. Do not intrude into those areas designated as habitat for endangered plant species.

### **3.02 DISPOSAL OF CLEARING AND GRUBBING DEBRIS**

- A. Remove cleared and grubbed material from the worksite and dispose of in accordance with these design and construction standards, local laws, codes, and ordinances.

### **3.03 AREAS TO BE STRIPPED**

- A. Strip excavation and embankment areas associated with the project, new structures, slabs, walks, and roadways. Strip stockpile areas.

\*\*\* END OF SECTION \*\*\*

## SECTION 02200

### EARTHWORK

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The work of this Section includes all earthwork required for construction of the Work. Such earthwork shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the work specified in the Contract Documents, which shall include, but not be limited to, the furnishing, placing, and removing of sheeting and bracing necessary to safely support the sides of all excavation; all pumping, ditching, draining, and other required measures for the removal or exclusion of water from excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to make up deficiencies for fills; and all other incidental earthwork, all in accordance with the requirements of the Contract Documents.

##### **1.02 CONTRACTOR SUBMITTALS**

- A. The Contractor's attention is directed to the provisions for "Shoring and Bracing Contract Documents" in Section 6705 of the Utah Labor Code. The Contractor, prior to beginning any trench or structure excavation 5 feet deep or over shall submit to the Owner and shall be in receipt of the Owner's written acceptance of the Contractor's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of Utah, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of Utah.

##### **1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Without limiting the generality of other requirements of the Contract Documents, all work specified herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. Commercial Standards:

ASTM D 422-63(1972)

Method for Particle-Size Analysis of Soils.

ASTM D 698-78

Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5lb (2.49kg) Rammer and 12-in (304.8 mm) Drop.

ASTM D 1140-54(1971)

Test Method for Amount of Material in Soils Finer than the No. 200 (75 mm) Sieve.

ASTM D 1556-82

Test Method for Density of Soil in Place by the Sand Cone Method.

ASTM D 1663-84

Test Method for Compressive Strength of Molded

|                      |  |
|----------------------|--|
| ASTM D 2419-74(1979) | Soil-Cement Cylinders.<br>Test Method for Sand Equivalent Value of Soils and Fine Aggregate.     |
| ASTM D 2487-83       | Classification of Soils for Engineering Purposes.  |
| ASTM D 2901-82       | Test Method of Cement Content of Freshly-mixed Soil Cement.                                      |
| ASTM D 2922-81       | Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth). |
| ASTM D 4318-84       | Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.                      |

#### **1.04 QUALITY ASSURANCE**

- A. General: All soils testing will be done by a testing laboratory of the Owner's choice at the Contractor's expense.
- B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with ASTM D 698. Field density in-place tests will be performed in accordance with ASTM D 1556, ASTM D 2922, or by such other means acceptable to the Engineer.
- C. In case the tests of the fill or backfill show non-compliance with the required density, the Contractor shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner and shall be at the Contractor's expense.
- D. Particle size analysis of soils and aggregates will be performed using ASTM D 422.
- E. Determination of sand equivalent value will be performed using ASTM D 2419.
- F. Unified Soil Classification System: References in these specifications to soil classification types and standards set forth in ASTM D 2487 shall have to meanings and definitions indicated in the chart illustrated at the end of this Section. The chart is reproduced herein for the convenience of the Contractor only, and no limitation, amendment, or modification is intended thereby. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

### **PART 2 -- PRODUCTS**

#### **2.01 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS**

- A. General: Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock or sand, free from grass, roots, brush, or other vegetation.
- B. Fill and backfill materials to be placed within 6-inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3-inches.
- C. Suitable Materials: Soils not classified as unsuitable as defined in paragraph entitled, "Unsuitable

Material" herein, are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the specified limitations. In addition, when acceptable to the Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

- D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required to meet the requirements of this Section or to meet the quantity requirements of the project the Contractor shall provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule.
- E. The following types of suitable materials are designated and defined as follows:
1. Type A: Crushed rock, gravel, or sand with 100 percent passing a 1-inch sieve and a sand equivalent value not less than 50.
  2. Type B: Crushed rock, gravel, or sand with 100 percent passing a ½-inch sieve and a sand equivalent value not less than 50.
  3. Type C: Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve, and a sand equivalent value not less than 30.
  4. Type D: Crushed rock or gravel with 100 percent passing a 1-inch sieve and not more than 10 percent passing a Number 4 sieve.
  5. Type E: Crushed rock or gravel with 100 percent passing a ½-inch sieve and not more than 0 percent passing a Number 4 sieve.
  6. Type E: Crushed rock or gravel meeting the following gradation requirements:

| Sieve Size | Percentage Passing |
|------------|--------------------|
| 2-inch     | 100                |
| 1½-inch    | 94-96              |
| 1-inch     | 20-40              |
| ¾-inch     | 4-8                |

7. Type G: Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the Contractor, the grading for either the 1½-inch maximum size or ¾-inch maximum size shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements:

| Sieve Size | Percentage Passing |            |
|------------|--------------------|------------|
|            | 1½-inch Max        | ¾-inch Max |
| 1½-inch    | 90-100             | -          |
| 1-inch     | -                  | 100        |
| ¾-inch     | 50-85              | 90-100     |
| No. 4      | 25-45              | 35-55      |
| No. 30     | 10-25              | 10-30      |
| No. 200    | 2-9                | 2-9        |

8. Type H: Drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

| Sieve Size | Percentage Passing |
|------------|--------------------|
| 1-inch     | 100                |
| ¾-inch     | 90-100             |
| 3/8-inch   | 40-100             |
| No. 4      | 25-40              |
| No. 8      | 18-33              |
| No. 30     | 5-15               |
| No. 50     | 0-7                |
| No. 200    | 0-3                |

The drainrock shall have a sand equivalent value not less than 75. The surface of the drainrock immediately beneath reservoirs shall be stabilized with hot-applied asphalt after the surface of the drainrock has been finish-graded. The Contractor shall use, at its option, one of the asphalt types listed below:

|                               | Type 1  | Type 2  |
|-------------------------------|---------|---------|
| Designation                   | SC-70   | SC-250  |
| Spray Temperature (degrees F) | 135-175 | 165-200 |
| Coverage (gal/sq yd)          | 0.50    | 0.50    |

If the surface remains tacky, sufficient sand shall be applied to absorb the excess asphalt.

9. Type I: Any other suitable material as defined in Paragraph 2.01, herein.
10. Type J: Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.
11. Type K: Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris as specified.

## 2.02 UNSUITABLE MATERIAL

- A. Unsuitable soils for fill material shall include soils which, when classified under the standard method for "classification of Soils, for Engineering Purposes," ASTM D 2487, fall in the classification of Pt, OH, CH, MH, or OL.
- B. In addition, any soil containing organic matter, having a plastic limit of less than 8-percent when tested in accordance with the requirements of ASTM D 4318 and containing more than 25 percent of material, by weight, passing the Number 200 sieve when analyzed according to the requirements of ANSI/ASTM D 1140; or any soil which cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use, shall be classed as unsuitable material.

## 2.03 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

- A. The Contractor shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.
- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction, or with the requirements of a material manufacturer, the Engineer shall be immediately notified. In case of conflict therewith, the Contractor shall use the most stringent requirement, as determined by the Engineer.
- C. Fill and backfill types shall be used in accordance with the following provisions:
  1. Embankment fills shall be constructed of Type I material, as defined in Paragraph 2.01E, herein, or any mixture of Type I and Type A through Type H materials.
  2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" herein, shall consist of the following materials for each pipe material listed below.
    - a. Mortar coated pipe, concrete pipe, and asbestos-cement pipe shall be provided Type A, B, C,

- D, or E pipe zone backfill material.
  - b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other coated pipe shall be backfilled with Type C pipe zone backfill material.
  - c. Plastic pipe and vitrified clay pipe shall be backfilled with Types B, C, or E pipe zone backfill material.
3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type I backfill material or any of Types A through H backfill materials or any mixture thereof.
  4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise noted on the Contract Documents.
  5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
  6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses shown or specified.
  7. Backfill around structures shall be Type I material, or Types A through Type H materials, or any mixture thereof.
  8. Backfill materials beneath structures shall be as follows:
    - a. Drainrock materials under reservoirs or other structures shall be Type H material.
    - b. Under concrete reservoirs, Types G or H materials shall be used, except where concrete encasement is required by the Contract Documents.
    - c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used.
    - d. Under structures other than concrete reservoirs, Type D, E, G, or H material shall be used, except where concrete encasement is required by the Contract Documents.
  9. Backfill used to replace pipeline trench over-excavation shall be Type F material for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.
  10. The top 6-inches of fill on reservoir roofs, embankment fills around reservoirs, and all other embankment fills shall consist of Type K material, topsoil.
  11. Where required by the Contract Documents, pea gravel shall be Type E material.

### **PART 3 -- EXECUTION**

#### **3.01 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION**

- A. **General:** Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. The removal of said materials shall conform to the lines and grades shown or ordered. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or shall be removed from the site prior to performing any excavation or placing any fill. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other approved measures for the removal or exclusion of water, including taking care of storm water, groundwater, and wastewater reaching the site of the work from any source so as to prevent damage to the work or adjoining property. Excavations shall be sloped or otherwise supported in a safe

manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

- B. Excavation Beneath Structures and Embankments: Except where otherwise specified for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where shown or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6-inches of native material and where such subgrade is sloped, the native material shall be benched at no additional cost to the Owner. When such over-excavation is shown on the Contract Documents, both over-excavation and subsequent backfill to the required grade shall be performed by the Contractor at its own expense. When such over-excavation is not shown but is ordered by the Engineer, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6- inches, brought to optimum moisture content, and rolled with heavy compaction equipment to 95-percent of maximum density.
- C. Excavation Beneath Concrete Reservoir: Excavation under the reservoir shall extend to the bottom of the drainrock layer. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95-percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock. Areas under the reservoir upon which fill is to be placed shall be scarified to a depth of 6-inches, brought to optimum moisture content, and compacted to 95-percent of maximum density.
- D. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base, if such base is called for; otherwise it shall extend to the paving thickness. After the required excavation has been completed, the exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to 95-percent of maximum density.
- E. Notification of Engineer: The Contractor shall notify the Engineer at least 3 days in advance of completion of any structure excavation and shall allow the Engineer a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

### **3.02 PIPELINE AND UTILITY TRENCH EXCAVATION**

- A. General: Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the Contractor, but shall be as shown on the typical trench detail.
- B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required.

- C. Open Trench: The maximum amount of open trench permitted in any one location shall be 500- feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. Special care shall be taken in late fall, winter and early spring to ensure material put back in the trenches is not frozen. All frozen material shall be removed from the trench prior to backfilling with non-frozen, appropriate material. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any travelled roadway or occupied structure. In such cases, however, barricades and warning lights meeting OSHA requirements shall be provided and maintained.
- D. Trench Over-Excavation: Where the Contract Documents indicate that trenches shall be over-excavated, they shall be excavated to the depth shown, and then backfilled to the grade of the bottom of the pipe. Work specified in this Paragraph shall be performed by the Contractor at its own expense.
- E. Over-Excavation: When ordered by the Engineer, whether indicated in the Contract Documents or not, trenches shall be over-excavated beyond the depth shown. Such over-excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the pipe. All work specified in this Section shall be performed by the Contractor at its own expense when the over-excavation ordered by the Engineer is less than 6 inches below the limits shown. When the over-excavation ordered by the Engineer is 6-inches or greater below the limits shown, additional payment will be made to the Contractor for that portion of the work which is located below said 6-inch distance. Said additional payment will be made under separate unit price bid items for over-excavation and bedding if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.
- F. Where pipelines are to be installed in embankment or structure fills, the fill shall be constructed to a level at least one foot above the top of the pipe before trench is excavated.

### **3.03 OVER-EXCAVATION NOT ORDERED, SPECIFIED, OR SHOWN**

- A. Any over-excavation carried below the grade ordered, specified, or shown, shall be backfilled to the required grade with the specified material and compaction. Such work shall be performed by the Contractor at its own expense.

### **3.04 EXCAVATION IN LAWN AREAS**

- A. Where excavation occurs in lawn areas, the sod shall be carefully removed and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition.

### **3.05 EXCAVATION IN VICINITY OF TREES**

- A. Except where trees are shown in the Contract Documents to be removed, trees shall be protected from injury during construction operations. No tree roots over 2-inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation as may be directed by the Engineer.

### **3.06 ROCK EXCAVATION**

- A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.
- B. Said rock excavation shall be performed by the Contractor at its own expense; provided, that should the quantity of rock excavation be affected by any change in the scope of the work, an appropriate adjustment of the contract price will be made under a separate bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price.
- C. Explosives and Blasting: Blasting will not be permitted, except by express permission of the Engineer on a case-by-case basis. The use of explosives will be subject to the approval and regulations of all agencies having jurisdiction. If blasting is utilized at the site of the Work, the Contractor shall take all precautions and provide all protective measures necessary to prevent damage to property and structures or injury to person. Prior to blasting, the Contractor shall secure all permits required by law for blasting operations and shall provide any additional hazard insurance required by the Owner. The Contractor shall have a fully qualified and experienced blasting foreman in charge of all blasting operations.
- D. The Contractor will be held responsible for all and shall make good any damage caused by blasting or resulting from its possession or use of explosives on the work.
- E. All operations involving the handling, storage, and use of explosives shall be conducted in accordance with the requirements of the OSHA Standards for Construction, and in accordance with all local laws and regulations.

### **3.07 DISPOSAL OF EXCESS EXCAVATED MATERIAL**

- A. The Contractor shall remove and dispose of all excess excavated material at its own expense.

### **3.08 BACKFILL - GENERAL**

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

- B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation.

### **3.09 PLACING AND SPREADING OF BACKFILL MATERIALS**

- A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness. When compaction is achieved using flooding and jetting methods, each layer shall not exceed 3-feet in thickness after compaction.
- B. During spreading each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.
- C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.
- D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

### **3.10 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS**

- A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined in Paragraph 2.01E, herein, where the material is graded such that at least 10 percent passes a Number 4 sieve, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.
- B. Each layer of Type D, E, F, and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor, except when such materials are used for pipe zone, backfill vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is least.
- C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.
- D. Flooding ponding, or jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.
- E. Pipe zone backfill materials that are granular, may be compacted by a combination of flooding and vibration using concrete vibrators or by jetting, when acceptable to the Engineer.
- F. Pipeline trench zone backfill materials, containing 5-percent or less of material passing a No. 200 sieve, may be compacted using flooding and jetting or vibration if the Contractor uses effective procedures that yield the specified compaction test results. Flooding and jetting shall not be done in such a manner that the pipe or nearby utilities are damaged, in areas of poorly draining or expansive soils, or where the use of the procedure is prohibited by any agency having jurisdiction over the

street or right-of-way. Approved jet pipes or immersible vibrators shall be used so that each backfill layer is saturated and consolidated to its full depth before the next layer is placed. Jet pipes shall be kept at least 6 inches away from the pipe where the backfill is being consolidated and 2-feet away from other pipes or utilities.

- G. Equipment weighing more than 10,000-pounds shall not be used closer to walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use heavier equipment is impractical or restricted due to weight limitations.
- H. Compaction Requirements: The following compaction test requirements apply to Type A, B, C, G, H, I, and K materials. Type D, E, F, and J materials do not require testing. Where agency or utility company requirements govern, the highest compaction standards shall apply.

| Location or Use of Fill   | Percentage of Maximum Density |
|---|-------------------------------|
| Pipe zone backfill portion above bedding for flexible pipe                              | 90                            |
| Pipe zone backfill bedding and overexcavated zones under bedding/pipe for flexible pipe | 90                            |
| Pipe zone backfill portion above bedding for rigid pipe.                                | 90                            |
| Pipe zone backfill bedding and over-excavated zones under bedding/pipe for rigid pipe.  | 90                            |
| Final backfill, beneath paved areas or structures.                                      | 95                            |
| Final backfill, not beneath paved areas or structures.                                  | 90                            |
| Trench zone backfill.   | 90                            |
| Embankments   | 90                            |
| Embankments, beneath paved areas or structures.   | 95                            |
| Backfill beneath structures, reservoirs.  | 95                            |
| Backfill around structures, on reservoir or structure roof.                             | 95                            |
| Topsoil (Type K material)   | 90                            |
| Aggregate base (Type G material)  | 95                            |

- I. The Contractor shall maintain the indicated trench cross section up to a horizontal plane lying 6-inches above the top of the pipe.

- J. If, at any location, under said horizontal plane the Contractor slopes the trench walls or exceeds the maximum trench widths indicated in the Contract Documents, the pipe zone backfill shall be "improved" or the pipe class increased as specified herein, at no additional cost to the Owner. "Improved" backfill shall mean sand-cement backfill or other equivalent method acceptable to the Engineer.
- K. If the allowable deflection specified for the pipe is exceeded, the Contractor shall expose and reround or replace the pipe, repair all damaged lining and coating, and reinstall the pipe zone material and trench backfill as specified at no additional expense to the Owner.

### **3.11 PIPE AND UTILITY TRENCH BACKFILL**

- A. Pipe Zone Backfill: The pipe zone is defined as the trench cross-sectional area between a line 6-inches below the bottom of the pipe, i.e., the subgrade, to a level line 6 inches above the top of the pipe. The bedding for flexible pipe is defined as that portion of pipe zone backfill material between the subgrade and the bottom of the pipe zone backfill material between the subgrade and a level line which varies from the bottom of the pipe to the springline as shown on the Contract Documents.
- B. Bedding shall be provided for all sewers, drainage pipelines, and other gravity flow pipelines. For other pipelines the bedding may be omitted if all the following conditions exist:
  - 1. The pipe bears on firm, undisturbed native soil which contains only particles that will pass a one-inch sieve.
  - 2. The trench excavation is not through rock or stones.
  - 3. The trench conditions match those specified by the pipe manufacturer for installation of pipe directly on the subgrade.
  - 4. The subgrade soils are classified as suitable fill and backfill materials per Paragraph 2.01.
  - 5. The subgrade soils have, as a maximum, a moisture content that allows compaction.
- C. Where bedding is required, after compacting the bedding the Contractor shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.
- D. The pipe zone shall be backfilled with the specified backfill material. The Contractor shall exercise care to prevent damage to the pipeline coating, cathodic bonds, or the pipe itself during the installation and backfill operations.
- E. Trench Zone Backfill: After the pipe zone backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the trench zone may proceed. The inches above the top of the pipe to a level line 18 inches below finished surface grade, or if the trench is under pavement, 18 inches shall be filled with water to prevent flotation.
- F. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18-inches of finished grade, or if the trench is under pavement, all backfill within 18-inches of the subgrade.

### **3.12 EMBANKMENT CONSTRUCTION**

- A. The area where an embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and

rolled or otherwise mechanically compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

- B. Where embankment or structure fills are constructed over pipelines, the first 4-feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.

\*\*\* END OF SECTION \*\*\*

## SECTION 02210

### SITE GRADING (Building Construction)

#### PART 1 -- GENERAL

##### 1.01 SCOPE OF WORK

- A. Principal work in this Section: Furnish materials and perform labor required to execute this work as indicated in the Contract Documents, as specified and as necessary to complete the Contract, including, but not limited to these major items:
1. Coordinate the work of this Section with other trades including off-site construction.
  2. Verify all elevations at the job site.
  3. Protect existing improvements designated to remain.
  4. All excavating, filling, backfilling, compacting and grading required for the project, except as excluded in Paragraph B below.
  5. Pumping, draining, shoring, cribbing, and other protective measures.
  6. Layout and setting of lines and levels.
  7. Cut, cap and remove inactive utility lines encountered in the path of new construction.
  8. Protect finished grading from damage.
  9. Remove surplus or unsatisfactory materials from the site including above or below grade improvements, such as footings, not removed during demolition operations.
- B. Related work specified elsewhere.
1. Above grade demolition.
  2. Trenching, backfilling and compacting for utilities.
  3. Base course and subgrade under asphalt paving.
  4. Soil enrichments and topsoil for landscaped areas.
  5. Finish grading for landscaping and asphalt paving.
  6. Cut, cap and remove inactive utility lines encountered in the path of new construction.

##### 1.02 SITE CONDITIONS

- A. Soils Investigation Reports: The soils investigation reports prepared for the project site shall be used to identify site conditions at the project.
- B. Data: Maps, boring logs, geotechnical and soils investigation reports, and like reference data, are not included in the Contract Documents but are made available to the Contractor for information only. Neither the Owner, Engineer or Architect shall assume any responsibility for any conclusions the Contractor may draw from such information. Information in the reports shall not relieve the Contractor of his responsibility for the work required. Logs of soil borings included in the above mentioned reports do not constitute a guarantee of the uniformity of soil conditions over the entire site, not a guarantee against variations of the ground water. The Contractor shall determine existing conditions under which he shall operate in performing the work.
- C. Site Visitation: In preparing the proposal, the Contractor is assumed to have visited the site, carefully examined the Contract Documents, and determined the methods of removal and storage of materials, the sequencing of operations and the attendant problems. No allowance will be made

subsequently to the Contractor for errors due to negligence in observing the site conditions.

- D. Earthwork Quantities: Any earthwork quantities shown in the Contract Documents are for permit purposes only. The Contractor shall be responsible for his own quantities.

### **1.03 QUALITY ASSURANCE**

- A. General: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work in this Section.
- B. Inspections and Tests: The Owner will employ a Soils Engineer to inspect and test the work of this Section. At the completion of this work the Soils Engineer will be required to submit a written report certifying that the site was developed with acceptable materials in accordance with the Contract Documents. The Soils Engineer shall be permitted free and unrestricted access to the site as required for the performance of his duties.

### **1.04 REFERENCE STANDARDS**

- A. General: Conform to the following reference standards to the extent specified.
- B. American Society for Testing and Materials (ASTM). D 1557-78: Test Methods for Moisture-Density Relations of Soils and Soils-Aggregate Mixtures using 10-lb. (4.54 kg.) Rammer and 18-in. (457mm.) Drop.
- C. State of Utah, Division of Industrial Safety.
- D. Ordinances. Codes and Regulations: Work shall be constructed in accordance with the requirements of all legally constituted authorities having jurisdiction. Including all local ordinances, codes and the safety orders of the State Division of Industrial Safety.

## **PART 2 -- PRODUCTS**

### **2.01 SOIL MATERIALS**

- A. General: Soil materials, in general, shall be free of debris, roots, wood, scrap material, vegetable matter, refuse soft unsound particles, frozen deleterious, or objectionable materials.
- B. Backfill and Fill: Backfill and fill shall conform to the general requirements for soil materials above for soil materials above and shall be an unclassified granular soil material from the site or borrow material. Maximum, particle size shall be 6-inches. Backfill and fill materials shall be approved by the Soils Engineer.
- C. Borrow Material: Obtain material required for fill in excess of that produces within the grading limits of the work from borrow areas selected and paid for by the Contractor and approved by the soils Engineer. Borrow material shall be granular and non-expansive of low expansion potential (expansion index less than 35) and shall contain sufficient fines (binder material) so as to be relatively impermeable when compacted. The Soils Engineer shall evaluate and/or test the

material for its conformance with the specification prior to the delivery to the site. The Contractor shall notify the Soils Engineer at least 72 hours prior to importing fill to the site. Rocks larger than 3-inches in diameter shall not be used unless they are sufficiently broken down.

### **PART 3 -- EXECUTION**

#### **3.01 PROTECTIVE MEASURES**

##### **A. Underground Utilities:**

1. Prior to the commencement of any excavations, telephone Blue Stakes Underground Service Alert. Two working days shall be allowed after contacting Blue Stakes before the excavation work is started to allow utility owners to be notified. If any utilities are to remain in place, provide adequate protection during earthwork operations to prevent damaging them.
2. Should uncharted or incorrectly charted utilities be encountered during excavation, notify the utility owner for instructions. Cooperate with the utility owner in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner and pay all costs thereof.
3. Should old utility lines be encountered which prove to be abandoned in place, they shall be removed as part of the excavation, or if sufficiently below grade, as determined by the Soils Engineer, may be capped and left in place.
4. If seepage pits or cesspools are encountered, do not fill until approval has been obtained from the Soils Engineer.
5. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, during occupied hours, except when permitted in writing and then only after acceptable temporary utility services have been provided.

##### **B. Drainage:**

1. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site and surrounding area. Grade perimeter of excavations so that water run-off drains away from the excavations.
2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting of footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering appurtenances necessary to convey water away from excavations.
3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting areas. Do not use trench excavations as temporary drainage ditches.
4. Dispose of water resulting from dewatering operations in a manner that will not cause damage to public or private property, or constitute nuisance or menace to the public in accordance with local requirements.
5. Protect sloped embankments from erosion and during rainy weather by covering with impermeable membranes or by using other approved methods.

- ##### **C. Shoring, Cribbing and Bracing:** Shore, crib and brace the excavations as necessary to prevent cave-ins and to support and protect adjacent construction, in accordance with Federal, State and local laws. All such shoring shall be designed by a licensed civil or structural engineer employed by the Contractor.

- D. Benchmarks and Monuments: Protect benchmarks, monuments, and other reference points against displacement and damage. Repair or replace benchmarks, monuments and other permanent survey data that becomes displaced or damaged due to the performance of this work at no cost to the owner.
- E. Dust Palliation: Control dust at the site by intermittent watering and sprinkling while the work of the Section is being performed.
- F. Preservation of Property from Damage: Existing improvements, adjacent property, utility and other facilities, and trees and plants that are not to be removed shall be protected from injury or damage. Repair or replace existing improvements damage during the conduct of this work with material of same kind, quality and size. Materials or equipment temporarily removed for protection and not damaged shall be reinstalled.
- G. Provide necessary barricades and protection to protect the public, personnel, equipment and premises from damage, harm, hazard or disturbance arising out of this work. Conduct work using the most quiet of available, suitable processes and equipment to keep noise down, and take necessary care to reduce amount of dust carried in the air, by an effective dust palliation program.
- H. Use of Explosives: The use of explosives is not permitted.
  - 1. Trees and plants that are not to be removed shall be protected from injury by the Contractor at his expense. Perform excavations within the drip-lines of large trees to remain by hand and protect the root system from damage or dry-out to the grades extent possible. Maintain a moist condition for the root system and cover exposed roots as directed by the Landscape Architect. Paint root cuts of one inch diameter and larger with emulsified asphalt tree paint.

### **3.02 GROUND SURFACE PREPARATION**

- A. Clearing and Grubbing: All vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish, debris and other unsatisfactory material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is started. The removals shall extend to a depth of three feet below the existing ground surface or subgrade, whichever is deeper.
- B. Benching: Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be plowed, stepped or benched, or broken up, as directed, in such manner that the fill material will bond with the existing surface and in accordance with the recommendations of the soils investigation report.
- C. Verification: Verify with the Soils Engineer that all site clearing work has been satisfactorily completed.
- D. Preparation of Subgrades:
  - 1. General area fills and backfills: Scarify the subgrade to a depth of at least 8-inches and compact to at least 90-percent of the maximum density obtainable by the ASTM D1557 method of compaction. Moisten or dry as necessary to obtain a moisture, content that does not vary more than two percent from optimum.
  - 2. Structural fills and backfills: Scarify the subgrade to a depth of at least 8-inches and compact to at least 95-percent of the maximum density obtainable by ASTM D1557 method of

compaction. Moisten or dry as necessary to obtain a moisture content that does not vary more than two percent from optimum.

### 3.03 EXCAVATION

- A. Excavate all materials encountered regardless of their nature to the lines and grades indicated or necessary to complete the work. Remove all existing fill soils and disturbed natural soils for their entire depth. Size excavations to allow for placing and removing formwork, installing protective shoring and bracing as may be necessary to prevent caving or sloughing of banks, and to allow for installation of waterproofing and other services.
- B. Clean out excavations of any loose material to firm undisturbed soil.
- C. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at Contractor's expense.
- D. Shore and crib excavations if required to maintain their stability.
- E. Material Storage: Stockpile satisfactory excavated materials until required for backfill of fill. Place, grade and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain. Dispose of excess soil material and waste materials as herein specified.
- F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe conditions until completion of backfilling.
- G. Slopes: When completed, the average plans of excavation slopes shall conform to the slopes indicated in the Contract Documents and no point on the completed slopes shall vary from the designated plane by more than 6-inches. All debris and loose material shall be removed.

### 3.04 FILLS

- A. Fills shall be constructed at the locations and to lines and grades indicated. The completed fill shall conform to the shape of the typical sections indicated or shall meet the requirements of the particular case. Compaction shall be continuous over the entire area. Equipment shall make sufficient passes to obtain a uniformly the desired density. Each lift shall be compacted before the overlaying lift as placed.
- B. General area fill shall be placed in loose lifts not to exceed 12-inches in depth. Each lift shall be compacted to a minimum of 95 percent of maximum dry density when tested in accordance with ASTM D1557. Flooding or jetting techniques to accomplish compaction will not be allowed.
- C. Soils shall be treated so that the moisture content at the time of compaction is near optimum. Do not place fill during unfavorable weather conditions. If work is interrupted by heavy rain, do not resume operations until the proper moisture content and density of materials have been achieved.

- D. Materials larger than 3-inches in size shall be placed in the fill so they are completely surrounded by compacted fine aggregate. No nesting of rocks will be permitted. Material placed within the upper 12-inches of fill shall be selected material that contains no rocks or hard lumps greater than 3-inches in size and shall have an expansion index of less than 35.
- E. If during the grading operations, soil types other than those analyzed in the soils report are encountered, consult the Soils Engineer to determine the suitability of these soils as fill materials.
- F. The Soils Engineer shall observe the placement of compacted fill and conduct in-place filed density tests on the compacted lifts to check for adequate moisture content and the required relative compaction. Where less than the required relative compaction is indicated, additional compaction effort shall be applied and the soil moisture conditioned as necessary until the required relative compaction is attained.

### **3.05 BACKFILLING**

- A. Place backfill as specified in paragraph 3.04 FILLS, as construction operations permit, but not before the following operations take place:
  - 1. Work to be covered has been inspected and approved.
  - 2. Concrete formwork and loose soils and debris have been removed from the excavation.
  - 3. Underground utility locations have been recorded.
  - 4. Shoring and bracing have been removed, voids have been filled and compacted.
  - 5. Waterproofing and prefabricated in-plane wall drainage system, if any, have been inspected and approved.
  - 6. Permanent or temporary horizontal bracing is in place on walls supported by a floor or roof.
- B. Compact backfill as specified in paragraph 3.04, FILLS.
- C. Where backfill is required on both sides of a structure, place it simultaneously so that the weight of fill remains approximately equal on both sides at all times.
- D. Brace construction which has not been designed to withstand eccentric loading during backfilling.
- E. Backfill only after the structure to be backfilled against has attained its design strength or has been properly braced to resist the load of the backfill. No compacting by flooding or jetting will be permitted.
- F. Keep rollers and other heavy equipment at least four feet from footings, foundations, piers and walls of building and appurtenance.

### **3.06 GRADING**

- A. The locations and elevations of all constructions are indicated in the Contract Documents and unless inconsistencies are brought to the City's attention in writing prior to commencement of work, the Contractor will be held responsible for the proper location and elevations of the completed work.
- B. Grade all areas to the lines and levels required. Finish areas free from irregular and abrupt surface changes. Keep grades straight between changes in elevations. Rough grading shall be within plus or minus 0.1-foot of the elevations shown in the Contract Documents. Finish grades shall be the

maximum elevations shown in the Contract Documents with a minus tolerance of ½-inch of uniformly distributed.

- C. For roadways, the required subgrade elevation shall be such that when base and indicated construction are added, the final elevations will be those shown in the Contract Documents.

### **3.07 DISPOSAL**

- A. Satisfactory excavated materials, in excess of that required for filling and backfilling, and unsatisfactory materials, shall be disposed of off-site in a legal manner.
- B. Burning and burying materials on-site is prohibited.

### **3.08 PROTECTION OF NEWLY GRADED WORK**

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerance.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather scarify surface re-shape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

### **3.09 FIELD QUALITY CONTROL**

- A. All site grading operations will be observed by the Soil Engineer. The Soil Engineer will have to following duties at a minimum:
  - 1. Observe the results of the clearing and grubbing operations to assure that all unsuitable materials have been properly removed.
  - 2. Inspect the exposed subgrade in fill areas, observe proofrolling, and delineate areas requiring overexcavation.
  - 3. Evaluate the suitability of on-site and import soils as structural fill.
  - 4. Perform field density tests to monitor the quality of compacted fill and backfill.
  - 5. Monitor foundation bearing materials to conform that appropriate bearing materials are present at the design grades. Recommend adjustments needed to construct footings.
- B. Field Density Tests:
  - 1. The location and frequency of the tests will be at the Soil Engineer's discretion.
  - 2. If, in the Engineer's opinion, based on reports submitted by the Soil Engineer, subgrade, fill and backfill have been placed below specified density or on improperly prepared subgrades, remove in-place soils, and provide additional compaction and tests at no additional costs to the Engineer.
- C. Notice: Provide the Soil Engineer at least two working days notice prior to start of each phase of

earthwork operations.

- D. Verifications of Elevations: Provide written certification by a licensed surveyor or civil engineer upon completion of earthwork operations that grades are within the tolerance specified.
- E. Lines and Levels: Employ a licensed surveyor or civil engineer to lay out the work and establish the necessary markers, benchmarks, batter boards and stakes.

### **3.10 ADJUSTING**

- A. Regrading: Raise or lower existing manholes and cleanouts in regraded areas and carefully remove, clean and reset frames and covers to finished grade.

### **3.11 CLEANUP**

- A. Cleanliness of Site: During progress of work, keep premises reasonably free of debris and waste materials.
- B. Removal of Debris: Upon completion and before final acceptance of work, remove all debris, rubbish, left-over materials, tools and equipment from site.
- C. Keep sidewalks and streets adjoining the property clean and free of debris, excavated materials, rubbish and other materials resulting from the performance of this work which might affect the safety and free passage of the streets, sidewalks, utilities and property.

\*\*\* END OF SECTION \*\*\*

## **SECTION 02222**

### **EXCAVATION AND BACKFILL FOR STRUCTURES**

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. This section covers excavating, backfilling and compacting for inlet structures, emergency spillway retaining wall, PDPE liner and manholes. Other structures may also conform to this section as directed by the City.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02292 – Embankment Construction
- B. Section 02712 – Storm Drainage System
- C. Section 03300 – Cast-in-Place Concrete

##### **1.03 SUBMITTALS**

- A. If requested by the City, the Contractor shall furnish to the Soils Engineer, a certified test results from an approved laboratory showing that the free draining gravel material and structural fill material conforms to the Contract Document requirements. The test result will be paid for by the City.

#### **PART 2 -- PRODUCTS**

##### **2.01 RETAINING WALL BACKFILL**

- A. Retaining wall backfill material shall be native material or shall be embankment fill material.
- B. Wall backfill material shall be free from frozen lumps, rocks larger than 6-inches in the largest dimension, roots, trash, lumber and organic material. Suitability of material for wall backfill in accordance with these criteria will be as determined by the Soils Engineer.

#### **PART 3 -- EXECUTION**

##### **3.01 EXCAVATION**

- A. Excavation shall be performed to the lines and grades indicated in the Contract Documents. During excavation, material satisfactory for backfilling shall be stockpiled in a safe manner. Excavated material not required or not satisfactory for backfill shall be removed from the site.
- B. Excavations shall be so braced and supported as needed to prevent the ground, adjacent to the

excavation, from sliding or settling. Localized slides or settlements shall be promptly removed and corrected by the Contractor.

### **3.02 BACKFILL**

- A. Backfill material shall not be placed against concrete structure that has not been properly cured. No backfill material shall be placed until concrete has cured for a minimum of 7 days or until the compressible strength is 3,000 psi, whichever is greater.
- B. Backfill material shall be placed in no more than 6-inch loose lifts.
- C. All backfill material shall be placed and compacted to at least 95-percent of Standard Proctor Density at a moisture content within plus 2-percent to minus 2-percent of optimum as determined by ASTM D-698.
- D. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and recompacted to the minimum required compaction, unless recommended otherwise by the Soils Engineer, prior to placing any additional fill material.
- E. Unless otherwise specified, the Contractor shall be responsible for arranging for the placing and compacting of approved fill material in accordance with the Contract Documents. If the Soils Engineer should determine that the Contractor is failing to meet the minimum requirements, the Contractor shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to the City.
- F. Sufficient personnel, equipment, sumps or other means should be provided to maintain the site in an acceptable dry condition for the duration of construction and curing of the structure.

### **3.03 REMOVAL OF WATER**

- A. Dewatering shall be accomplished in accordance with Section 01525 – Temporary Construction Aids and Environmental Controls. The Contractor shall provide and maintain at all times, ample means and devices with to remove promptly and to properly dispose of all water entering the excavation.
- B. Water shall be disposed of in a suitable manner without damage to adjacent property or without being a menace to public health and convenience. No water shall be drained into work built under construction without prior approval of the City.
- C. Dewatering shall be accomplished by well, points, sumping, or any other acceptable method, which will provide a dewatered excavation. Any dewatering method shall be subject to the approval of the City.

### **3.04 COMPACTION TESTS**

- A. Field density tests shall be made in accordance with ASTM D698.
- B. The cost of field density tests shall be borne by the Contractor.

\*\*\* END OF SECTION \*\*\*

## SECTION 02271

### EROSION CONTROL

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to install, maintain and remove temporary erosion control as shown and as directed by the City, including coordinating temporary control measures with permanent control requirements.

##### **1.02 RELATED WORK AND REFERENCES**

- A. Section 02292 – Embankment
- B. Section 02273 – Interceptor, Roadway and Toe Ditch

##### **1.03 TEMPORARY BERM**

- A. Temporary berms consist of a ridge of compact soil, with or without a shallow ditch, constructed at the top of fill slopes, or transverse to the centerline of fills.

##### **1.04 SLOPE DRAIN**

- A. Slope drains carry water down cut and fill slopes to prevent erosion before installation of permanent facilities or the growth of adequate ground cover.

##### **1.05 SEDIMENT STRUCTURES**

- A. Sediment structures consist of various types of structures to trap and store sediment.
  - 1. Permanent sediment basins are excavated storages of defined side slopes with riprap placed at the inlet and outlet and are limited to drainage areas of 50 acres or less. Basins shall be checked and maintained per Subsection 3.01.J.
  - 2. Silt fence is a temporary structure of steel fence posts, wire mesh fencing and a permeable filter fabric used on drainage areas of one acre or less.

##### **1.06 CHECK DAM**

- A. A check dam is a barrier composed of stones placed across a natural or constructed drainage channel. Do not consider a check dam as a substitute for a sediment basin or silt fence. A check dam does not reduce the required sediment capacity of these facilities.

## **PART 2 -- PRODUCTS**

### **2.01 TEMPORARY BERM**

- A. Existing soil

### **2.02 TEMPORARY SLOPE DRAIN**

- A. Pipe Culvert
- B. Riprap – Refer to Section 02275
- C. End Section

### **2.03 SEDIMENT STRUCTURES**

- A. Existing soil
- B. Riprap – Refer to Section 02275

### **2.04 SILT FENCE**

- A. Wood or steel posts – 5-feet in length
- B. Galvanized steel wire mesh – 1/12-inch minimum, 6 by 6-inch opening maximum.
- C. Filter fabric
  - 1. Synthetic filter fabric (pervious sheet of propylene, nylon, polyester or ethylene yarn and allow a flow rate of 0.06 gal/sq.yd. min. and have a filter efficiency of 97-percent.
  - 2. Synthetic filter fabric will contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F.

### **2.05 CHECK DAMS**

- A. Check dams are constructed using the following materials:
  - 1. Stone – As specified
  - 2. Silt fence – Refer to Subsection 2.06

## **PART 3 -- EXECUTION**

### **3.01 STANDARD PROCEDURES**

- A. The Contractor will develop an Erosion Control Plan for all phases of work altered or added to the project. Submit the plan two weeks prior to clear and grub activities for approval by the City.
- B. Coverage under all necessary permits will terminate upon completion of the project.

- C. The Erosion Control Plan shall address the following items:
  1. Staging areas
  2. Haul roads and borrow sites
  3. Disposal areas
  4. Topsoil storage
  5. Wood chip stockpiles
  6. Alteration and/or additions to the location and type of fence, sediment structures, check dams and other erosion control devices.
- D. Do not start earth-disturbing work until temporary erosion control measures are in place.
- E. Install all erosion control in a timely manner and as a proactive measure to prevent erosion during construction.
- F. Space surface runoff control structures as follows:

| SLOPE GRADIENT<br>(percent) | STRUCTURE INTERVAL<br>(feet) |
|-----------------------------|------------------------------|
| 10                          | 150                          |
| 15                          | 100                          |
| 20                          | 50                           |
| 30                          | 40                           |
| 40                          | 36                           |
| 50 or greater               | 30                           |

- G. Do not pollute streams, canals, lakes or other watercourses. Use the erosion control measures indicated. Notify the City immediately upon discovery of any pollution of these watercourses.
- H. Use the Erosion Control Plan and Contract Documents when constructing erosion control items.
- I. Use the most restrictive requirements if a conflict occurs between erosion control specifications and federal, state, or local agency's laws, rules or regulations.
- J. Maintain erosion control facilities during the construction period, including shutdown periods. At the end of each shift, the Contract shall inspect temporary erosion control measures to ensure that they are in place and functioning properly. At least once a week, the Contractor shall clean, adjust and otherwise maintain temporary erosion control measures.
- K. Erosion control measures shall be checked after every storm event.
- L. All erosion control measures shall be cleaned and maintained when no more than half of the design volume has been filled with collected sediment and repaired when damaged or deemed ineffective.
- M. Remove sediment when it reaches a depth that interferes with the operation of the structure.

- N. Use and maintain sediment structures until all disturbed areas draining into it are lined or has established vegetation.
- O. When removing sediment structures, comply with Subsection 3.01.G.

### **3.02 TEMPORARY BERM**

- A. Place and compact the entire width of the berm in accordance with Section 02292 – Dam Embankment Construction.
- B. Grade the area at inlet and outlet to drain.
- C. Extend all transverse berms on the downstream side of the slope drain across the grade at the approximate 10-degree angle with a line perpendicular to centerline.
- D. Widen the tip width of the transverse berm and flatten the side slopes in order to facilitate passage of equipment over them.
- E. Before achieving final roadway elevations, construct embankments with the surface super elevated, permitting the placement of temporary berms and side drains on the low side of the roadway section.
- F. Construct temporary berm Type B during all full suspensions of work.

### **3.03 TEMPORARY SLOPE DRAIN**

- A. Place drains at maximum intervals of 1,000-feet along a continuous slope.
- B. Anchor temporary slope drain.
- C. Use pipe end section or lining at drain inlet.
- D. Use pipe end section, loose riprap and sediment trap at drain outlet.

### **3.04 PERMANENT SEDIEMENT BASIN**

- A. Locate basins as shown on the project drawings.

### **3.05 SILT FENCE**

- A. The height of a silt fence shall be a minimum of 16-inches above the original ground surface and will not exceed 35-inches above ground elevation.
- B. Cut fiber fabric to the full length of the barrier to avoid the use of joints or seams. When joints or seams are unavoidable, splice filter cloth together at a support post, with a minimum 6-inch overlap and securely seal.
- C. When wire mesh is used to support filter fabric, place posts a maximum of 10-feet apart. When wire mesh is not used to support filter fabric, place posts at a maximum of 6-feet apart.

D. When a silt fence is constructed across a ditch line or swale, the measure must be of sufficient length to eliminate end flow. The plan configuration shall resemble an arc or horseshoe with the ends oriented upslope. Place posts a maximum of 3-feet apart.

E. Toe in silt fence and wire mesh as shown on the Standard Drawings.

### **3.06 CHECK DAMS**

A. Refer to Contract Documents.

\*\*\* END OF SECTION \*\*\*

## SECTION 02272

### FABRIC, EROSION CONTROL MATS AND GEOTEXTILES

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to install geotextiles as indicated in the Contractor Documents.

##### **1.02 RELATED WORK AND REFERENCES**

- A. Section 02925 – Topsoil
- B. Section 02933 – Seeding
- C. Section 02273 – Interceptor, Roadway and Toe Ditch

##### **1.03 USAGE**

- A. Any fabric, erosion control mat or geotextile to be used on the project, including recommended products, must be approved by the City. The Contractor must submit samples, calculations and a manufacturer's letter of recommendation for usage of their product for its proposed purpose on this project.

##### **1.04 PERMANENT USAGE**

- A. All fabric, erosion control mats and geotextiles to be used on the project shall be manufactured for permanent erosion control.

##### **1.05 METHOD OF INSTALLATION**

- A. The Contractor shall submit an installation plan to the City for approval. The installation plan must be approved by the City prior to installation of fabric, erosion control mat or geotextile.

##### **1.06 PRODUCT SUBSTITUTION**

- A. Criteria for approved equals shall include, but not be limited to, velocity, shear sediment loss and vegetation density.

##### **1.07 DEFINITIONS**

- A. A *sandy soil* is one with a USDA soil texture classification of any of the following: sand, loamy sand, sandy clay loam or a sandy clay.

- B. A *non-sandy soil* is one with a USDA soil texture classification of any of the following: loam, silt loam, silt, clay loam, silty clay loam, silty clay or clay.

**PART 2 -- PRODUCTS**

**2.01 TOE DITCH**

- A. Turf reinforcement mat (TRM) – Use *Bon Terra America SFB12* or approved equal.

**2.02 INTERCEPTOR DITCH**

- A. Permanent erosion and reinforcement matrix – Use *Synthetic Industries – PYRAMAT Erosion Matrix* or approved equal.

**2.03 ROADWAY DITCH**

- A. Turf reinforcement mat (TRM) – Use *Bon Terra America SFB12* or approved equal.

**2.04 CUT AND FILL SLOPES**

- A. Soil retention blanket, Type 1
1. Use *North American Green SC150, Xcel Superior*, or approved equal for slopes steeper than 3:1 up to and including 2:1 in sandy soils.
  2. Use *North American Green S75, Xcel Superior*, or approved equal for slopes steeper than 3:1 up to and including 2:1 in non-sandy soils.
- B. Soil retention blanket, Type 2
1. Use *North American Green SC150* or approved equal for 1.5:1 slopes in all soil types.

**2.05 BLANKET DRAIN AND SPECIFIED CLAY REMOVAL AREAS**

- A. Filter fabric, Type A – Use *Mirafi 140N Nonwoven Polypropylene Filter Fabric* or approved equal.

**2.06 RIPRAP LOCATIONS AND STABILIZED CONSTRUCTION ENTRANCE**

- A. Filter fabric, Type B – Use fabric with the properties list in the following table:

| PHYSICAL PROPERTY     | REQUIREMENTS                        |
|-----------------------|-------------------------------------|
| Grab tensile strength | 220 lbs. (ASTM D1682)               |
| Elongation failure    | 60-percent (ASTM D1682)             |
| Mullen burst strength | 430 lbs. (ASTM D3768)               |
| Puncture strength     | 125 lbs. (ASTM D751)                |
| Equivalent opening    | Size 40-80 (US std Sieve)(CW-02215) |

## **PART 3 -- EXECUTION**

### **3.01 STANDARD PROCEDURES**

- A. Inspection and testing - Obtain test samples and test for acceptance of geotextile prior to delivery of the geotextile to the project. A minimum of three random samples of the geotextile is required.
- B. Basis for rejection - Should any individual sample selected at random fail to meet any specification requirement, and then reject that roll and obtain two additional samples at random. If either of these two additional samples fails to comply with any portion of the specification, reject the entire quantity of rolls represented by that sample.
- C. Shipment and storage – Protect the geotextile from direct sunlight, chemicals, mud, dirt and debris during shipment and storage. Replace, at the Contractor's expense, any geotextile damaged or deteriorated during shipping, storage or construction.
- D. Packaging requirements – Wrap the geotextile uniformly onto suitable cylindrical forms or cores to aid in handling and unrolling. Package each roll of geotextile and the form or core upon which it is rolled to ensure protection of the geotextile from damage due to ultraviolet light and moisture during normal storage and handling.
- E. Labeling or tagging – Identify each roll by a tag or label securely affixed to the outside of the roll on one end. This tag or label must list the following required information: Name of the manufacturer, brand name of the product, roll width, roll length, and roll weight.
- F. Place the geotextile on an area that is smooth, free of projections or depressions. Do not drag the fabric across the subgrade, but roll out as smoothly as possible in the direction of vehicle travel. Remove wrinkles and folds to the City's satisfaction by stretching and staking as required.
- G. Overlap the longitudinal and transverse joints as per manufacturer's recommendations or file sew to provide 90-percent of the fabric strength. Thread shall be polypropylene. Secure the edges of the fabric by 10-inch long pins placed at a minimum of 10-feet on centers for parallel rolls and 5-feet on centers for roll ends. Use 1/4 –inch diameter pins in conjunction with 1 1/2-inch diameter washers.
- H. No construction equipment is allowed to run over or operate directly on the geotextile. A minimum of 6-inches of fill is required to be placed on the geotextile before construction equipment may run over or operate on the geotextile.
- I. Slope stability measures shall be in place no later than 3 weeks after placing fill to finished grade.

### **3.02 DITCH**

- A. Install geotextile in accordance with the approved Installation Plan per Subsection 1.05 – Method of Installation.

B. Seeding

1. When seeding prior to geotextile installation, all check slots and other areas disturbed must also be reseeded.
2. When soil filling, seed geotextile and entire disturbed areas after installation, prior to filling mat with soil.

**3.03 CUT AND FILL SLOPES**

- A. Follow manufacturer's recommended installation procedures for installing soil retention blankets.
- B. The soil retention blanket, whether installed as slope protection or as a flexible channel liner in accordance with the approved materials list, shall be placed within 24 hours after seeding or sodding operations have been completed, or as approved by the City. Prior to placing the blanket, the area to be covered shall be relatively free of any rocks or clods over 1-1/2-inches in dimension and all sticks or other foreign material which will prevent the close contact of the blanket with the soil. The area shall be smooth and free of rills and other depressions. If, as a result of rain, the prepared bed becomes crusted or eroded or if any eroded places, ruts or depressions exist for any reason, the Contractor shall be required to rework the soil until it is smooth and to reseed or resod the area at the Contractor's expense.
- C. Installation and anchorage of the soil retention blanket shall be in accordance with the manufacturer's recommendations and the Contract Documents.
- D. The Contractor shall submit one full set of manufacturer's literature and manufacturer's installation recommendation for the soil retention blanket selected in accordance with the approved materials list.

**3.04 BLANKET DRAIN AND SPECIFIED CLAY REMOVAL AREAS**

- A. Follow manufacturer's recommended installation procedures for installing filter fabric in the locations specified in the Contract Documents.

**3.05 RIPRAP LOCATIONS AND STABILIZED CONSTRUCTION ENTRANCE**

- A. Follow manufacturer's recommended installation procedures for installing filter fabric in the locations specified in the Contract Documents.

\*\*\* END OF SECTION \*\*\*

**SECTION 02273**  
**INTERCEPTOR, ROADWAY**  
**AND TOE DITCH**

**PART 1 -- GENERAL**

**1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to construct ditches and channels as shown in the Contract Documents. This includes placing and compacting suitable material in embankments and disposing of unsuitable material.

**1.02 RELATED WORK AND REFERENCES**

- A. Section 02933 - Seeding  
B. Section 02274 – Clay Liner  
C. Section 02272 – Fabrics, Erosion Control Mats and Geotextiles

**PART 2 -- PRODUCTS**

**2.01 DRAIN ROCK**

- A. Free draining material meeting the following gradation:

| SIEVE SIZE | PERCENT PASSING |
|------------|-----------------|
| 1-inch     | 100             |
| ½-inch     | 25-60           |
| No. 4      | 0-10            |

**2.02 RIPRAP**

- A. Refer to Section 02275 – Riprap.

**PART 3 -- EXECUTION**

**3.01 STANDARD PROCEDURES**

- A. Construct ditches of the type shown in the locations contained in the Contract Documents.  
B. Form the ditch as shown in the Contract Documents. Place excavated material in embankments.  
C. Dispose of excess or unsuitable material at locations acceptable to the City.

\*\*\* END OF SECTION \*\*\*

## **SECTION 02274**

### **CLAY LINER**

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to construct clay ditch liner for the interceptor ditches as indicated in the Contract Documents.

##### **1.02 RELATED WORK AND REFERENCES**

- A. Section 02271 – Temporary Erosion Control
- B. Section 02112 – Clearing, Grubbing and Stripping
- C. Section 02273 – Interceptor, Roadway and Toe Ditch
- D. Section 2292 – Dam Embankment Construction

#### **PART 2 -- PRODUCTS**

##### **2.01 LINER MATERIAL**

- A. Liner material will require a permeability of less than  $2 \times 10^{-6}$  ft/min. The soil shall have a plasticity index (PI) of 15 or greater with 100-percent passing the 3-inch sieve and a minimum of 40-percent passing the No. 200 sieve. The liner material shall be free of brush, roots, sod, perishable, unsuitable or frozen material. Native subgrade soils may be used if soil criteria are met.

#### **PART 3 -- EXECUTION**

##### **3.01 STANDARD PROCEDURES**

- A. Construct clay liner as shown in the Contract Documents.
- B. Prior to placing liner fill, the existing ground surface shall be prepared by removal of all brush, roots, sod, other perishable material, frozen or other unsuitable material.
- C. Liner material shall consist of layers of soils, which have been scarified, moisture conditioned to between optimum and 2-percent over optimum and compacted to at least 98-percent of the maximum dry density as determined by AASHTO T-180.

### **3.02 ACCEPTANCE TESTING**

- A. Quality control testing: The Contractor shall be responsible for quality control of the canal lining.
- B. Compacting testing: Acceptance procedures for compaction: Clay liner will be tested per UDOT Subsection 225.3.3.

\*\*\* END OF SECTION \*\*\*

## SECTION 02275

### RIPRAP

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to install riprap as shown in the Contractor Documents. This includes but is not limited to protection of channels, structures and embankments.
- B. The Contractor shall supply and install geotextile fabric and riprap in accordance with the requirements of the Contract Documents.
- C. As used in this specification riprap is a layer of stone or rock designed to protect and stabilize the surface of the soil from erosion from water or wind. Riprap may be used to stabilize cut and fill slopes, channel slopes and bottoms, inlets and outlets for culverts, bridges, slopes drains and shorelines to due wave action.

Riprap is classified as either graded or uniform. Graded Riprap includes a wide range of stone or rock sizes. Uniform riprap consists of stone or rocks approximately the same size.

Graded riprap is preferred to uniform as it provides a dense, flexible cover. Riprap sizes are designed by either the mean diameter or the weight of the stones.

Proper slope selection and surface preparation are essential for successful long-term functioning riprap. Adequate compaction of fill areas and proper use of filter blankets are necessary

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02200 – Earthwork
- B. Section 02292 – Embankment
- C. Section 02272 – Fabrics, Erosion Control Mats and Geotextiles
- D. Section 02112 – Clearing, Grubbing and Stripping

##### **3.1 SUBMITTALS**

- A. Submit a letter-identifying source of stone.
- B. Submit analysis from an independent laboratory showing specific gravity, gradation, absorption and durability of stone.

#### **PART 2 -- PRODUCTS**

##### **2.01 RIPRAP MATERIAL**

- A. The riprap material shall be sound, durable rock, which is roughly rectangular in shape and of

suitable quality to ensure permanence in the condition in which it is to be used. Rounded stone, boulders, sandstone, or similar soft stone or relatively thin slabs will not be acceptable. Material shall be free from overburden, spoil, shale, and organic material.

- B. **Gradation:** The riprap should be a well graded mixture with 50% by weight larger than the specified design mixture should be 1.5 times the d50 size with smaller sizes grading down to a minimum one inch and shall meet the requirements of Table 1 or this specification.

The design criteria for sizing stone for stability is in the USDA, SCS field Design Manual, Manual of standards for Erosion and Sediment Control Measures. The minimum thickness of the riprap protection should be 1.5 times the maximum stone diameter, but shall not be less than nine inches.

- C. **Specific gravity:** The specific gravity of the individual stones should be at least 2.5.
- D. The individual classes of rocks used shall conform to the following chart:

| RIPRAP GRADATION* |              |              |               |              |              |              |
|-------------------|--------------|--------------|---------------|--------------|--------------|--------------|
| ROCK SIZE         | ½ TON RIPRAP | LIGBY RIPRAP | FACING RIPRAP | NO. 1 RIPRAP | NO. 2 RIPRAP | NO. 3 RIPRAP |
| ½ Ton             | 0-5 %        |              |               |              |              |              |
| ¼ Ton             | 50-100 %     | 0-5 %        |               |              |              |              |
| 100 lb.           |              | 50-100 %     | 0-5 %         | 0-5 %        |              |              |
| 75 lb.            | 95-100 %     |              | 50-100 %      | 25-75 %      | 0-5 %        |              |
| 25 lb.            |              | 95-100 %     | 90-100 %      | 90-100 %     | 25-75 %      | 0-5 %        |
| 5 lb.             |              |              |               |              | 90-100 %     | 25-75 %      |
| 1 lb.             |              |              |               |              |              | 90-100 %     |

\*The gradation in the chart represents the percent that shall be larger than the rock size called out in the left-hand column of the chart.

- B. The sizes of stone used for riprap protection are determined by purpose and site specific conditions.
- C. **Bedding:** Bedding for riprap shall be well graded, hard, durable aggregate and shall meet the following gradation:

| SCREEN OR SIEVE SIZE | % OF MATERIAL PASSING |
|----------------------|-----------------------|
| 3-inch               | 90-100                |
| ¾-inch               | 20-90                 |
| No. 4                | 0-20                  |
| No. 200              | 0-3                   |

- G. **Rock Dimensions:** Rock for outlet protection specified by size shall conform to subsection 2.01.A. The dimension in any plane shall not be less than 25-percent of the dimensions in the Contract Documents.

**3.1 QUALITY CONTROL**

- A. Visual evaluation of the quarry, including examination of blast samples and diamond drill core samples and suitable tests and service records, may be used to determine the acceptability of the stone. Notify the City in writing of the intended source of stone at least 30 days prior to use. Rock from onsite excavations conforming to these requirements may be used.
- B. To determine the required quality, provide specific gravity, absorption and durability tests of stone as follows:

| TEST                      | TEST METHOD                                | REQUIREMENT                   |
|---------------------------|--|-------------------------------|
| Apparent Specific Gravity | ASTM C 127                                 | 2.48 min.                     |
| Absorption                | AASHTO 785                                 | 4.2-percent max.              |
| Durability (abrasion)     | ASTM C 535                                 | 40-percent max.               |
| Durability (freeze/thaw)  | AASHTO T-104<br>5 cycles of sodium sulfate | 16-percent max<br>weight loss |

Based on the formula below, absorption may exceed 4.2-percent if the durability absorption ratio (DAR) is greater than 10. Durability may be less than 52 if DAR is greater than 24.

$$\text{DAR} = \frac{\text{Course Durability Index}}{\text{Percent Absorption} + 1}$$

**2.02 GEOTEXTILE FABRIC**

- A. The geotextile fabric to be used shall consist of nonwoven, needle-punched, polypropylene or polyester material. The material shall have a minimum fabric weight of 4.5-ounces per square yard and an EOS of 70 to 100.
- B. Material shall be Crown-Zellerbach grade 400 Fibretex, Phillips Petroleum Supac 5-p, or Celanese Fibers Mirafi 140 N.
- C. A geotextile fabric may be used with or in place of gravel filters. The following particle size relationship shall exist.
1. Geotextile fabric covering a base with granular particles containing 50-percent or less (by weight) of fine particles (less than US Standard Sieve No. 200 (0.074 mm).

$$\frac{d_{85} \text{ base (mm)}}{\text{EOS filter fabric (mm)}} > 1$$

- Total open area of the filter should not exceed 36-percent
2. Geotextile Fabric covering other soils:
    - a. EOS is no larger than the US Standard Sieve No. 70 (0.21mm)
    - b. Total open area of the filter should not exceed 10-percent
  3. The EOS is the Equivalent Opening Size compared to a US standard sieve size.

### **PART 3 -- EXECUTION**

#### **3.1 INSTALLATION**

- A. Remove stumps, brush, trees and unacceptable materials from the surface. Grade areas to a smooth surface.
- B. Scarify subgrade soils to a depth of at least 10-inches. The scarified soils shall be moisture-conditioned to or slightly above optimum moisture content. Scarified soil shall be compacted to at least 90-percent relative compaction. Relative compaction is defined as the ratio of the in-place soil density to the laboratory maximum dry density as determined by the AASHTO T-99 or T-180 test procedure.
- C. Use bedding material as necessary to place filter fabric on an area that is smooth and free of depressions or projections.
- D. Following installation of filter fabric, place stone for riprap on 6-inches of bedding material in a manner which will produce a well-graded mass of stone with the minimum practical percentage of voids. Place the riprap to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material.

#### **3.02 GEOTEXTILE FABRIC**

- A. The geotextile fabric shall be installed with a minimum lap width of 12-inches and in accordance with the manufacturer's recommendations.

\*\*\* END OF SECTION \*\*\*

## **SECTION 02276**

### **STABILIZED CONSTRUCTION ENTRANCE**

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to the site entrance as shown in the Contract Documents. This includes grading and compacting the area and placing the riprap.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02275 - Riprap
- B. Section 02272 – Fabrics, Erosion Control Mats and Geotextiles
- C. Section 02112 – Clearing, Grubbing and Stripping
- D. Standard Drawing No. 5105 – Temporary Gravel Construction Entrance/Exit

#### **PART 2 -- PRODUCTS**

##### **2.01 STABILIZED CONSTRUCTION ENTRANCE**

- A. Riprap (No. 3) – Refer to Section 02275 – Riprap.
- B. Filer fabric per Section 02272 – Fabrics, Erosion Control Mats and Geotextiles.

#### **PART 3 -- EXECUTION**

##### **3.01 STANDARD PROCEDURES**

- A. Clear all vegetation, roots and all other obstructions in preparation for grading.
- B. Prior to placing filter fabric, make sure that the entrance is properly graded and compacted.
- C. To reduce maintenance and loss of aggregate, place filter fabric over the existing ground before placing the stone for the entrance.
- D. Place riprap as shown in the Contract Documents.

##### **3.02 MAINTENANCE**

- A. Inspect the entrance at the end of each shift, after significant truck traffic and after every storm event for riprap displacement and sediment buildup.
- B. Apply additional rip when required.

- C. Remove sediments from within the entrance when they prevent proper drainage of the facility.
- D. Provide a vehicle wash-down area with appropriate facilities for vehicles that leave the site. Ensure that all vehicles leaving the site have been properly washed-down and are not tracking dirt, mud or other debris onto existing City streets.
- E. Immediately remove sediment and other materials tracked off the site.
- F. Maintain associate temporary erosion control measures per Section 02271 – Temporary Erosion Control.

\*\*\* END OF SECTION \*\*\*

## SECTION 02277

### SEGMENTAL BLOCK RETAINING WALL

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to for installing segmental block retaining wall to the lines and grades indicated in the Contract Documents. This includes furnishing and installing geogrid and appurtenant materials when required for construction of the retaining wall.
- B. Prior to installation, the Contractor shall submit texture and color samples of the concrete blocks for approval by the City. Entire wall shall be constructed of the same block, texture and color.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02292 – Embankment Construction
- B. Manufacturer's specifications and recommendations

#### **PART 2 -- PRODUCTS**

##### **2.01 SEGMENTAL RETAININ WALL UNITS**

- A. Segmental block retaining wall units shall be KEYSTONE or approved equal.
- B. All units shall be sound and free of cracks or other defects that would interfere with proper placing of the unit or significantly impair the strength or performance of the construction. Cracking or excessive chipping shall be grounds for rejection.
- C. Concrete used to manufacture segmental retaining wall units shall have a minimum 28-day compressive strength of 3,000 psi. The concrete shall have adequate freeze/thaw protection with a maximum moisture absorption rate, by weight of 8-percent.
- D. Segmental retaining wall units molded dimensions shall not vary in size by more than plus or minus 0.08-inches in width or plus or minus 0.04-inches in height from that specified by the manufacturer.
- E. Units shall be positively engaged to the unit below (use connection pins if required) so as to provide 0.75-inch to 1-inch horizontal setback.

##### **2.02 LEVELING PAD MATERIAL**

- A. As per manufacturer's recommendations.

### 2.03 MODULAR BLOCK UNIT FILL

- A. Use free draining crushed stone ½-inch to 1-inch with no more than 5-percent passing the No. 200 sieve, within the modular block units requiring fill material.

### 2.04 GEOGRID

- A. The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and retain its geometry under construction stresses and shall have high resistance to deformation under sustained long-term load. The geogrid shall be resistant to damage during construction, to ultraviolet degradation and to all forms of chemical and biological degradation encountered in the material being reinforced.
- B. Provide junction strength, minimum GRI-GG2 of 90-percent of ultimate strength.
- C. Provide maximum strain of 10-percent for tension creep test, 10,000 hours for 75-year design life, GRI-GG3.
- D. Provide a long-term allowable design load (100-year) of 1,350 pounds per foot.

### 2.05 SELECT BACKFILL MATERIAL

- A. Provide backfill free from organic and/or deleterious material conforming to the following gradation:

| SIEVE SIZE | PERCENT PASSING |
|------------|-----------------|
| 6-inch     | 100             |
| 3-inch     | 75-100          |
| No. 40     | 0-60            |
| No. 200    | 0-15            |

### 2.06 FIBERGLASS PINS

- A. If recommended by the manufacturer, provide fiberglass pins to interlock the units.

### 2.07 PORTLAND CEMENT CONCRETE

- A. Class AA (AE) Concrete.

## **PART 3 -- EXECUTION**

### 3.01 FOUNDATION SOIL PREPARATION

- A. Excavate the foundation soil to the lines and grades shown in the Contract Documents or as directed by the Engineer.

- B. Fill the over-excavated areas with compacted select backfill material.

### **3.02 LEVELING PAD**

- A. As per manufacturer's recommendations.

### **3.03 MODULAR BLOCK UNIT INSTALLATION**

- A. Place the first course of concrete wall units on the leveling pad. Check the wall units for level and alignment. The first course is the most important to ensure accurate and acceptable results.
- B. Ensure units are in full contact with the leveling pad.
- C. Install connecting pins in modular block units if the manufacturer recommends them.
- D. For block units requiring fill material, fill all voids in block units with modular block unit fill. Tamp fill. Ensure each wall course is completely filled, backfilled and compacted prior to proceeding to the next wall course.
- E. Lay each course ensuring connecting pins protrude into adjoining courses above a minimum of 1-inch. Pull each block unit forward, away from the embankment, against connecting pins in the previous course and backfill as the course is completed. Repeat procedure to the extent of the wall height.
- F. As appropriate where the wall changes elevation, the units can be stepped with grade or turned into the embankment with a convex return end. Provide appropriate buried units on the compacted leveling pad in the area of the convex return end.

### **3.04 WALL CAP INSTALLATION**

- A. Provide a permanent connection between the wall cap units and the top course of the wall units. Use an approved construction adhesive or epoxy for the connection.

### **3.05 GEOGRID INSTALLATION**

- A. Install geogrid according to block manufacturer's recommendations.
- B. Lay the geogrid soil reinforcement horizontally on compacted backfill. Connect to the concrete wall units by hooking the geogrid over the connection pins if pins are required. Otherwise, connect as per the manufacturer's recommendations. Pull the geogrid taut and anchor it before backfill is placed on the geogrid.
- C. Remove the slack in the geogrid at the wall unit connection.
- D. Lay the geogrid at the proper elevations as indicated on the structural drawing.
- E. Verify the correct orientation (roll direction) of the geogrid.

- F. Pull the geogrid taut to eliminate loose folds and pretension the geogrid. Stake or secure the back edge of the geogrid before and during backfill and compaction.
- G. Follow the manufacturer's guidelines relative to overlap requirements of uniaxial and biaxial geogrids.

### **3.06 FILL PLACEMENT**

- A. Place the backfill material in 8-inch lifts and compact.
- B. Place, spread and compact the backfill in a manner that minimizes the development of slack or loss of pretension of the geogrid.
- C. Use only hand-operated compaction equipment within 3-feet of the back surface of the block units.
- D. Place the backfill from the wall rearward into the embankment to ensure the geogrid remains taut.
- E. Do not operate tracked construction equipment directly on the geogrid. Before operation of tracked vehicles, a minimum backfill thickness of 6-inches is required over the geogrid. Keep to a minimum, the turning of tracked vehicles to prevent tracks from displacing the fill and damaging the geogrid.
- F. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds, less than 10 miles per hour. Avoid sudden braking and sharp turning.

\*\*\* END OF SECTION \*\*\*

## **SECTION 02279**

### **SILT FENCE**

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to install environmental fence.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Standard Drawing No. 5100 – Silt Fence

#### **PART 2 -- PRODUCTS**

##### **2.01 FENCE**

- A. Polyethylene, high density, UV stabilized
- B. Width – 48-inch minimum
- C. Tensile Strength – 300-lbs along outside edge minimum
- D. Aperture Size – 2-inches to 4-inches by 0.5-inches
- E. Color - Orange

##### **2.02 METAL POSTS**

- A. 59-inches to 71-inches long line post – T section
- B. Anchor plates optional
- C. Painted or galvanized

##### **2.03 TWINE, WIRE OR PLASTIC TIES**

#### **PART 3 -- EXECUTION**

##### **3.01 STANDARD PROCEDURES**

- A. Prior to installation, the limits of disturbance for the project shall be surveyed by a licensed land surveyor to determine the location of the silt fence.
- B. Once the limits of disturbance have been surveyed and marked in the field, the Contractor is to then install the silt fence.
- C. Install per manufacturer's recommendations.

- D. Install posts at a spacing such that the fence does not sag more than 2-inches between posts.
- E. Weave the fence over the support post alternating every 2 loops and secure it to the posts with twine, wire or plastic ties.
- F. Inspect the fence weekly and submit the proper report to the City.
- G. Maintain the fence during construction
- H. Remove the fence and post upon completion of construction and dispose of them properly.

\*\*\* END OF SECTION \*\*\*

**SECTION 02290**  
**STORM DRAIN DETENTION BASIN**  
**EMBANKMENT**

**PART 1 -- GENERAL**

**1.01 SCOPE OF WORK**

- A. This section covers the preparation and placement of fill for the construction of the proposed storm drain detention basin embankment.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 01500 – Temporary Construction Aids and Environmental Controls
- B. Section 02222 – Excavation and Backfill for Structures
- C. Section 02710 – Toe Drain
- D. Section 02720 – Storm Drain
- E. Section 02770 – High Density Polyethylene Liner

**1.03 NOTIFICATION**

- A. A minimum of 48 hours notice shall be provided to the Engineer to schedule inspection of the embankment foundation. Prior to the placement of embankment fill, the Engineer must approve the embankment foundation.

**PART 2 -- PRODUCTS**

**2.01 EMBANKMENT FILL MATERIALS**

- A. Embankment fill materials are to be from sources designated by the Engineer. Available soils for the embankment are detailed in the Geotechnical report for the project. Soils in this area are highly erodible and are to be protected from erosion during the construction.
- B. To protect the embankment from erosion, the embankment will be covered with topsoil meeting the topsoil specifications specified in Section 02925.

**PART 3 -- EXECUTION**

**3.01 SITE PREPARATION**

- A. All work within the project will be performed in accordance with any necessary permits.

- B. Site Dewatering: The toe drain and outfall line shall be constructed prior to construction of the embankment to provide for dewatering of the foundation.
- C. Prior to placing the embankment materials, the subgrade soils that contain a large amount of organics shall be removed from below the embankment areas. Care shall be taken not to disturb the natural soils below the embankment. The subgrade shall be scarified and recompacted. Prior to placement of the embankment, the embankment foundation must be approved by the Engineer (see Section 1.03 – Notification).

### **3.02 EMBANKMENT FILL PLACEMENT**

- A. Embankment fill soils shall be placed in 10-inch maximum loose lifts. The minimum dry density of the compacted fill soils shall be 95-percent of the maximum dry density of the soil as determined by ASTM D-698. The fill shall be compacted at a moisture content within 2-percent of the optimum moisture content as determined by ASTM D-698.
- B. No oversize or segregated material shall be placed so as to nest, or in such a way as to rest against any hard structural surface (such as any portions of the outlet primary spillway pipe or emergency spillway retaining wall).
- C. At least one in-place density test shall be performed for each lift of embankment fill. Any test, which indicates the fill does not meet the above, stated in-place density requirements shall be redone immediately after the fill area has been subjected to additional compaction by the Contractor. This procedure shall be followed until tests show that the lift has been compacted to the required density. Retests shall be marked as such.

\*\*\* END OF SECTION \*\*\*

## **SECTION 02291**

### **EMBANKMENT**

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to place materials from roadway excavation or borrow, in embankments, including but not restricted to compacting, shaping and maintaining as shown, as well as filling holes, pits and other depressions when unsuitable material has been removed.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02293 – Slope Contouring
- B. Section 0212 – Clearing, Grubbing and Stripping

#### **PART 2 – PRODUCTS** – Not Used

#### **PART 3 -- EXECUTION**

##### **3.01 STANDARD PROCEDURES**

- A. Areas to receive compacted fill shall be stripped of all vegetation, organics and debris. Topsoil shall be stripped and stockpiled in an approved location. Any additional existing nonstructural fill materials and other unsuitable soils shall be excavated as directed by the City. All areas to receive compacted fill shall be observed by the City prior to placement of fill.
- B. Compacted fill soils shall consist of excavated on-site, non-expansive or blended soils, or imported soils approved by the City. All fill materials shall be free from organic matter and other deleterious material. All imported material shall be granular and nonexpansive with the liquid limit of the fines not exceeding 35 and the plastic index less than 15.
- C. Imported materials shall be evaluated and/or tested by the Engineer for conformance with the specifications prior to delivery to the site. The Contractor shall notify the City at least two working days prior to importing fill to the site.
- D. Do not disturb areas outside the limits established by environmental and silt fences without written approval. Submit a request in writing to the City.

##### **3.02 EMBANKMENT**

- A. Following the removal of unsuitable materials, subgrade soils surfaces that will receive compacted fill shall be scarified to a depth of at least 10-inches. The scarified soils shall be moisture-

conditioned to or slightly above optimum moisture content. Scarified soil shall be compacted to at least 90-percent relative compaction. Relative compaction is defined as the ratio of the in-place soil density to the laboratory maximum dry density as determined by the AASHTO T-180 test procedure.

- B. Compact the scarified subgrade to at least 90-percent of maximum laboratory density.
- C. In areas requiring embankment base stripping, the entire area receiving fill shall be stripped to the depth and limits shown in the Contract Documents. Once stripping is complete, the subgrade shall be scarified and compacted in accordance with Section 3.02.A.
- D. Spread embankment materials uniformly in layers not to exceed 10 to 12-inches (non-compacted) lifts and compact to at least 96-percent of maximum laboratory density before placing the next layer. Reduce the uncompacted fill thickness if tests shown unsatisfactory density.
- E. Pavement base and subbase materials shall be compacted to at least 96-percent of the AASHTO T-180 laboratory maximum density.
- F. All fill soils shall be compacted mechanically to the specified density.
- G. The City shall observe the placement of compacted fills and may conduct in-place field density tests periodically to verify compliance with these specifications.
  - 1. The Contractor shall provide level testing pads for the City to conduct field density tests on.
  - 2. The Contractor shall provide safe and timely access for the City's personnel throughout the project site for testing and observation purposes.
  - 3. Where compaction is not in compliance, appropriate steps shall be taken by the Contractor as necessary to bring the fill into compliance.
- H. At any location, where in the opinion of the City, an unstable condition is being created, the work shall not proceed until an investigation has been made and the grading plan revised, if necessary.
- I. Any rock or irreducible material 6-inches or larger shall not be placed in fills within 5 vertical feet of finished grade, within 10 horizontal feet of a slope face or near future utilities or underground construction. Disposal of the material shall be such that nesting does not occur and the material is completely surrounded by compacted fill.
- J. Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Engineer indicate that the moisture content and density of the fill are as previously specified.
- K. Finish subgrade surface with 0.1-feet of line and grade.
- L. Route construction equipment uniformly over the layers to assist compaction.
- M. Do not use compacting equipment that causes shear failure in the embankment.
- N. Requirements for freezing or snowy conditions are as follows:
  - 1. Do not place embankment on frozen or snow covered areas.

2. Do not deliver or use frozen material in embankments.
3. The Contractor may remove snow and frozen material from embankments, foundations and borrow areas and furnish unfrozen embankment material that can be compacted to the specified density, but such work will be at the Contractor's expense. Remove, wastes and replace frozen material at no additional cost to the Contract.

### **3.03 DRAINAGE**

- A. The Contractor shall grade and maintain the roadway to ensure adequate drainage
- B. Maintain pipe culverts and drainage ditches.
- C. Provide temporary facilities when interrupting irrigation systems, sewer, underdrainage, etc.
- D. Earth-moving and other construction operations shall be controlled to prevent water from running into excavated areas.
- E. Excess water shall be promptly removed and the site kept dry.

### **3.04 SUBSURFACE CONDITIONS**

- F. In such case that the grading contractor encounters subsurface conditions at the site that are materially or otherwise different than those indicated in the Contract Documents, the grading contractor shall immediately notify the City or the City's representative verbally and in writing within 24 hours.

### **3.05 SUBDRAIN**

- G. Subdrains shall be installed prior to fill placement.
- H. Subdrains shall be installed in canyons and ravines as shown in the Contract Documents.
- I. The clean-out and Subdrain area shall be observed and approved by the City prior to Subdrain installation. Subdrain installation may be modified by the City based on removal observations. Any modifications to the installation procedure or materials required shall constitute a change in scope in the Contract Documents.
- J. Discharge from subdrains shall be directed to a suitable nonerosive device. If the subdrain discharges into a storm drain, measures shall be taken to prevent storm drain water from backing up into the subdrain.

### **3.6 OVEREXCAVATION**

- A. If clay or other unsuitable, expansive material is exposed once construction has begun, these materials shall be overexcavated 3-feet and replaced with compacted fill.

### **3.7 CUT/FILL TRANSITIONS**

- A. Through all areas of cut/fill transitions, the entire cut portion of the cross-section shall be

overexcavated 3-feet below final grade and replaced with compacted structural fill to finish grade as shown in the Contract Documents.

### **3.08 CUT SLOPES**

- A. The Engineer shall conduct geologic investigations and measurements of all cut slopes during excavation to observe if any adversely oriented planes of weakness are present.
- B. Use stabilization fills as directed by the Engineer to stabilize any adversely oriented planes of weakness.

### **3.09 FILL SLOPES**

- A. In addition to normal compaction procedures, fill slopes should be properly compacted out to the slope face. To achieve this compaction, the Contactor may:
  - 1. Overbuild fill slopes and cut back to the compacted core, or
  - 2. Back-roll side slopes with sheepfoot rollers at increments of 2 to 3-feet in fill elevation gain, or
  - 3. Use other proven methods approved by the Engineer.
- B. Feathering of fills over the tops of slopes shall not be permitted.
- C. Keyways/Benching
  - 1. Where fills are placed on natural ground steeper than 5:1, the compacted fill shall be keyed and benched into firm material as indicated in the Contract Documents.
  - 2. The keyways shall be a minimum of 15-feet wide and at least 2-feet deep and shall carry a 2-percent slope from toe to heel.
  - 3. Benches shall be excavated into firm, competent soil to a depth of at least 4-feet. The Engineer shall approve all keyways and benches prior to fill placement.
- D. Backdrains
  - 1. At least one backdrain shall be placed at the heel of keyways where fill slopes exceed 25-feet vertically.
  - 2. Backdrains shall consist of 6-inch diameter (minimum) perforated pipe embedded in 3 cubic feet of gravel per linear foot of pipe, connected to a nonperforated outlet pipe.

### **3.10 STABILIZATION FILLS**

- A. Need for stabilization fills will be determined by the Engineer during grading.
- B. Where required, stabilization fills shall be constructed as indicated in the Contract Documents. Existing slopes shall be cut back to 1:1. Normal fill procedures apply with a backdrain provided at the heel of the keyway, and every 25-feet vertically.
- C. Any stabilization fills that are required solely due to adversely oriented planes of weakness uncovered during excavation shall constitute a change in scope in the Contract Documents.

### **3.11 EROSION CONTROL**

- A. Cut and fill slopes shall be graded and landscaped to reduce water-induced surficial erosion/sloughing. Permanent erosion control measures shall be implemented immediately after the completion of slope construction.
- B. All interceptor ditches, drainage terraces, down-drains and any other drainage devices shall be maintained and kept free of debris. Run-off shall be directed to a suitable nonerosive drainage device and shall not flow uncontrolled off-site.
- C. The Contractor shall implement additional short-term erosion control measures as directed by the Engineer to eliminate any observed significant erosion. Short-term non-plant erosion control measures shall be approved by the Engineer prior to installation.
- D. Erosion due to rodent burrowing, small concentrations of uncontrolled surface/subsurface water or poor compaction of utility trench backfill on slopes shall be repaired and controlled as soon as possible.
- E. All possible precautions shall be taken to maintain moderate, uniform soil moisture. Temporary irrigation systems shall be properly maintained and operated.
- F. If completion of new slopes occurs during the rainy season, contingency plans shall be developed to provide prompt temporary protection against any erosion or sloughing. Off-site improvements shall be protected from site run-off.
- G. Any erosion damage which occurs prior to the acceptance of the project shall be repaired by the Contractor.

\*\*\* END OF SECTION \*\*\*

**SECTION 02293**  
**SLOPE CONTOURING**

**PART 1 -- GENERAL**

**1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to excavate, blend and reshape the slopes as shown in the Contract Documents. The purpose of the slope contouring work is to create a blended and natural appearance on the finished slope that is similar to the adjacent and existing terrain.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02292 – Embankment Construction

**PART 2 – PRODUCTS** – Not Used

**PART 3 -- EXECUTION**

**3.01 STANDARD PROCEDURES**

- A. Use appropriate equipment to perform the work.
- B. Do not create unstable conditions as a result of the slope contouring.
- C. Reshape the slopes in designated areas prior to any topsoil placement.
- D. Coordinate slope-contouring work with the City. Make any adjustments necessary in equipment or methods that would minimize the work effort as directed by the City.

\*\*\* END OF SECTION \*\*\*

## SECTION 02606

### MANHOLES

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The Contractor shall furnish and install precast manholes in the locations shown in the Contract Documents.
- B. This section covers the materials and installation of precast concrete manholes. Sizes and dimensions of manholes shall be as shown on the drawings. Refer to the Concrete Section for requirements of cast-in-place concrete bases for manholes.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 03302 - Concrete
- B. Section 02204 - Earthwork
- C. Section 02667 - Hydraulic Structures and Pipeline Testing
- D. Section 02617 - Reinforced Concrete Pipe

##### **1.03 REFERENCE DOCUMENTS**

- A. City Storm Drainage and Flood Control Standards. Applicable requirements of appropriate subsections of the Draper City Storm Drainage and Flood Control Design and Construction Standards are hereby incorporated into these specifications:
- B. The requirements of this section are presented to supplement or supersede where noted the above listed subsections of the City Wastewater Standards. Except where it is noted that a particular requirement is superseded, cases where these specifications conflict with the incorporated City Wastewater Standards, the more stringent requirements providing for higher quality materials or workmanship, as interpreted by the Engineer, shall prevail.
- C. Commercial Standards.
  - ASTM C 478                      Pre-cast Concrete Manholes
  - Federal Specification
  - SS-S-00210                      Plastic Sealing Gasket

#### **PART 2 -- PRODUCTS**

##### **2.01 PRECAST SECTIONS**

- A. Manholes shall be constructed of precast concrete manhole rings set on a cast-in-place concrete base as shown. Precast concrete rings shall be manufactured by a process that will produce homogeneous

concrete ring meeting the requirements of the "Standard Specifications for Precast Reinforced Manhole Sections" (ASTM C 478-78). Manhole rings shall have a minimum wall thickness of 4-inches if steel reinforced and 6-inches if not reinforced. Cement used in manufacturing the rings shall be Type V as specified in the "Standard Specifications for Portland Cement" (ASTM C 150). Each ring shall have tongue-and-groove end sections cast into the top and bottom. The manufacturer of manhole rings shall be approved by the City.

- B. Frames and Covers. Castings for manhole frames and covers shall conform to the requirements of the "Standard Specifications for Gray Iron Castings", Class 35 (ASTM A 48). The bearing surfaces of the frames and covers shall be machined, and the cover shall seat firmly into the frame without rocking. Both frames and covers shall be dipped in commercial quality asphalt paint. Castings shall be marked to meet the Owner's requirements.

Manholes shall have watertight frames and bolt-down covers with stainless steel cap screws and a composition gasket. Watertight manhole frames and covers shall be Alhambra Foundry Company Model A-1254 B-6, or equal.

- C. Steps. Manhole steps, where specifically shown on the Drawings, shall be fabricated of 3/4-inch stainless steel or steel reinforced plastic, and internally cast into the manhole concrete sections. Maximum spacing between steps shall be 15-inches or as required by Cal OSHA or local codes.

## **2.02 INTERIOR COATING**

- A. Manhole Interior Coating: Coating shall be a polymorphic resin as manufactured by Integrated Environmental Technologies or approved equivalent. Such coating system shall be as detailed in "Specification 3000" for "Manhole Renovation & Protection" as published by Integrated Environmental Technologies, a copy of "Specification 3000" is appended at the end of this specifications.

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

- A. Precast manhole sections shall be installed as shown on the Plans. All manholes shall be installed to have watertight barrel sections and inlet-outlet connections. Manholes in areas subject to inundation shall have watertight frames and covers. Manhole rings shall be jointed together with a non-butyl bitumen sealant, which meets the requirements of AASHTO specification M198-75, Type R, such as Ram-Nek, as manufactured by K.T. Snyder and the joints shall be watertight. An enamel pore sealer such as Ram-Nek Primer, or equal, shall be applied to both the tongue and groove ends of each manhole ring before it is shipped from the factory. The non-butyl sealant shall be applied in sufficient volume such that when the mating surfaces are joined, visible evidence of sealant squeeze-out is observed continuously around the outside circumference of each joint. The first precast section shall be set on the cast-in-place monolithic base before the base has taken initial set, or the section shall be mortared into a suitably shaped groove formed in the top of the monolithic base. The first section shall be brought to true grade and alignment with all inlet pipes properly installed to form an integral, watertight unit.

Flow channels through the base of the manhole shall be made to conform accurately to the sewer grade, and alignment shall be merged smoothly with well-rounded junctions. Channel sides shall be brought vertically to the crown elevation, and the shelf shall be smoothly finished to the indicated slope.

Pipe connections to manholes shall be water tight and one of two types: (1) rigid, non-plastic pipe shall be cast into the base and shall be provided with flexible joints within 12 inches of the manhole wall, and such pipe connections within the manhole zone shall be bedded on a firm compacted foundation; (2) connections for flexible and semi-rigid plastic pipe shall be provided with a rubber water stop cast into the concrete base to form a water tight joint that permits longitudinal pipe movement. Drawings and samples of manhole water stops and gaskets for flexible pipe connections shall be submitted to the ENGINEER for review as required by the Section entitled "Contractor's Submittals." Installation of flexible pipe connection materials shall be per manufacturer's instructions.

Foundation bedding and backfill for manholes shall meet the most stringent requirements for those pipes entering the manhole as specified in Section 02200.

### **3.02 INTERIOR COATING**

- A. Manhole Interior Coating. The interior of all new manhole sections shall be lined with a polymorphic resin coating system. The application of this coating system shall be as detailed in "Specification 3000" for "Manhole Renovation & Protection" as published by Integrated Environmental Technologies, a copy of "Specification 3000" is appended at the end of this specifications. The specified mechanical application of the coating system may be waived providing skilled workmen, with prior experience in applications of polymorphic resin coatings, by other means, are used Documentation of workmens' experience will be required.

### **3.03 TESTING**

Manholes shall be tested as required in Section 02667.

\*\*\* END OF SECTION \*\*\*

## SECTION 02617

### REINFORCED CONCRETE PIPE

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The Contractor shall furnish, install, and test all reinforced concrete culvert and storm drain pipeline, complete in place, including connection to existing and new structures, all in accordance with the requirements of the Contract Documents.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Construction of catch basins and headwalls shall conform to the requirements of Section 03300 entitled, "Cast-in-Place Concrete," Section 03304 "Minor Concrete," and Section 03480 "Precast Concrete Specialties," as applicable.
- B. Trenching and backfilling shall conform to the requirements of Section 02200 "Earthwork."
- C. Manhole construction shall conform to the requirements of Section 03480 "Sewerage and Drainage System Appurtenances."
- D. Field testing shall conform to the requirement of Section 02750 "Storm Drainage System Testing."

##### **1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the referenced standards; provided, that wherever the provisions of said publication are in conflict with the requirements specified herein, the more stringent requirement shall apply.

##### **1.04 CONTRACTOR SUBMITTALS**

- A. The Contractor shall furnish certificates to the Engineer guaranteeing that the pipe furnished hereunder is in compliance with the requirements of these Specifications.
1. Commercial Standards:
    - ASTM C33      Specifications for Concrete Aggregate
    - ASTM C76      Specification for Reinforced Concrete Culvert Storm Drain and Sewer Pipe
    - ASTM C150     Specifications for Portland Cement
    - ASTM C443     Specifications for Rubber Gaskets

## **PART 2 -- PRODUCTS**

### **2.01 PIPE MATERIALS**

- A. Reinforced Concrete Pipe: Reinforced concrete pipe shall conform to the requirements of ASTM Designation C 76-82b with Type V cement; provided that pipe shall have tongue and groove joint designated to be self-centering and to leave a recess on the inside of the pipe for pointing with mortar after jointing. Pipe shall be designated for an internal pressure of 25-feet of water, and an external load of 1500-D.
- B. Cement Mortar: Cement mortar shall consist of a mixture of portland cement, sand, and water. Cement and sand shall first be combined in the proper proportions, and then thoroughly mixed with the required amount of water.
- C. Cement mortar shall be designated by class and proportioned by loose volume in the proportion of 1 part cement and 2 parts sand.
- D. The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended.
- E. Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be permitted.
- F. Cement, sand, and water for cement mortar shall conform to the requirements of Section entitled, "Cast-in-Place Concrete."
- G. Admixtures: No admixture shall be used in mortar unless otherwise specified or accepted by the Engineer.
- H. Quick Setting Grout: Quick setting grout shall be a high strength, non-staining grout approved by the Engineer prior to use. It shall reach an initial set within 90 minutes at 70 degrees F (21 degrees C) and shall reach minimum compressive strength of 2,500 psi (17mPa) within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596-82. The grout shall be mixed, handled, and placed in accordance with the manufacturer's written instructions.

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

- A. The pipe shall be placed with the minor axis of the reinforcement in a vertical position. Mortar for jointing pipe shall be composed of 1 part of cement and 2 parts of clean, well-graded sand of such size that all will pass a No. 8 sieve. The consistency of laying mortar shall be such that it will adhere to the ends of the pipe while being laid and be easily squeezed out of the joint when the pipe while being laid and be easily squeezed out of the joint when the pipe sections are pressed together. Pointing and bonding mortar shall be plastic and of such consistency that it will readily adhere to the pipe.

- B. In advance of jointing sections of concrete pipe, the ends of each section shall be washed clean with a wet brush and, immediately prior to placing mortar and jointing the sections, the ends shall be thoroughly wetted. After laying, the joints on the inside shall be swabbed smooth, and all excess mortar shall be removed from the pipe, after which backfilling shall be performed.
- C. Backfill over the pipe shall not be commenced within 16 hours of jointing pipe sections. Care shall be used to make sure that the bottom of the pipe is in contact with the bottom of the trench for the full length of each section.

\*\*\* END OF SECTION \*\*\*

## SECTION 02667

### HYDRAULIC STRUCTURES AND PIPELINE TESTING

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The CONTRACTOR shall perform all cleaning, flushing, and testing, including conveyance of test water from source to point of use, and including all disposal thereof, complete and acceptable, for hydraulic and appurtenant piping all in accordance with the requirements of the Contract Documents.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Testing of pipeline except appurtenant piping to the hydraulic structure(s) shall be tested according to the applicable provisions of the pipe schedule in the Drawings and by this reference thereto, said provisions shall be a part of this Section. The CONTRACTOR shall provide all temporary closure fittings necessary to test pipelines. This shall include plugs, bulkheads, valves, caps or welded plates on steel pipes.
- B. Repair of hydraulic structures, as required, shall conform to the provisions of Section entitled, "Cast-in-Place Concrete."

##### **1.03 CONTRACTOR SUBMITTALS**

- A. The CONTRACTOR shall submit minimum 48-hour advance written notice of its proposed testing schedule for review and concurrence of the ENGINEER. The Contractor's proposed plans for water conveyance, control, and disposal shall also be submitted in writing.

#### **PART 2 -- PRODUCTS**

##### **2.01 MATERIALS REQUIREMENTS**

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the CONTRACTOR subject to the Engineer's review. No material shall be used which would be injurious to the construction or its future function.

#### **PART 3 -- EXECUTION**

##### **3.01 GENERAL**

- A. The CONTRACTOR shall make all necessary provisions for providing testing water for the project. CONTRACTOR shall also make all necessary provisions for conveying the water from

the source to points of use and for disposing of the water upon completion of testing.

- B. All hydraulic structures and appurtenant piping shall be tested. All testing operations shall be done in the presence of the ENGINEER.
- C. If industrial paint finishes or other protective coatings are to be applied to the surfaces of the hydraulic structure, such coatings shall be applied after all testing operations have been completed.
- D. Release of water from structures, after testing has been completed, shall be approved by the ENGINEER.

### **3.02 PRELIMINARY CLEANING AND FLUSHING**

- A. Prior to testing, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with high-pressure hoses and nozzle of sufficient size to deliver a minimum flow of 50-gpm.

### **3.03 TESTING OF HYDRAULIC STRUCTURES**

- A. General. Testing shall be performed prior to backfilling, except where otherwise permitted by the ENGINEER. Testing shall not be performed sooner than 14 day after all portions of structure walls have been completed. The test shall consist of filling the structure with water to the maximum operating water surface. The rate of filling shall not exceed 24 inches of depth per day.
- B. Leakage Test and Repairs. After the structure has been filled, the leakage test shall be performed as follows: An initial water level reading shall be made. Seven days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the 2 water level readings, does not exceed 0.7 percent of the total volume of water in the structure, after allowance is made for evaporation loss. Should the structure fail to pass the test, the test shall be repeated for up to 3 additional 7-day test periods. If at the end of 28 days, the structure still fails to pass the leakage test, the CONTRACTOR shall empty the structure as approved by the ENGINEER and shall examine the interior for evidence of any cracking or other conditions that might be responsible for the leakage. Any cracks shall be "vee'd" and sealed with rubber sealant in accordance with the manufacturer's recommendations. Any evidence of leakage through the joints shall be repaired. Following these operations, the CONTRACTOR shall again test the hydraulic structure.

### **3.04 TESTING OF APPURTENANT PIPING**

- A. Piping appurtenant to hydraulic structures shall be tested as specified in the Piping Schedule in the Contract Documents.

\*\*\* END OF SECTION \*\*\*

## SECTION 02710

### TOE DRAIN

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to install all pipe, fittings, closure pieces, gaskets, jointing material, non-woven geotextile filter fabric, granular filter material and appurtenances as shown and specified and as required for a complete and workable toe drain system.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02222 – Excavation and Backfill for Structures  
B. Section 02712 – Storm Drainage System

##### **1.03 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

|              |   |
|--------------|---|
| AWWA M 23    | Manual of Water Supply Practices – PVC Pipe – Design and Installation   |
| ASTM D 422   | Particle-Size Analysis of Soils   |
| ASTM D 698   | Test Method of Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.5-kg) Rammer and 12-inch (305 mm) Drop |
| ASTM D 2321  | Recommended Practice for Installation of Corrugated Polyethylene Pipe   |
| ASTM D 3034  | Standard Specifications for Sewer Pipe and Fittings   |
| AASHTO M 252 | Corrugated Polyethylene Drainage Tubing   |

##### **1.4 SUBMITTALS**

- A. Submittals required for pipe, filter fabric and granular filter material.

#### **PART 2 – PRODUCTS**

##### **2.1 PIPING**

- A. Perforated toe drainpipe shall be corrugated polyethylene pipe conforming to AASHTO M 252 with nominal perforations of 2-square inches per foot.

##### **2.2 NON-WOVEN GEOTEXTILE FABRIC**

- A. The geotextile filter fabric shall be Polyfelt TS 700 non-woven geotextile fabric manufactured by Polyfelt, Inc. or approved equal.

## 2.3 GRANULAR FILTER MATERIAL

- A. Granular filter material shall be free draining material, clean, hard, tough, durable and sound mineral aggregate that consists of crushed stone, or crushed gravel; free of deleterious and organic matter; and shall comply with the following:
1. Rodded weight: Not less than 75 pounds per cubic foot
  2. Material passing No. 40 sieve: Nonplastic
  3. Meet the following gradation as shown in the following table

| GRANULAR FILER MATERIAL<br>GRADATION |                                     |
|--------------------------------------|-------------------------------------|
| SIEVE SIZE<br>(Square Opening)       | PERCENT BY WEIGHT<br>PASSING SCREEN |
| 2-inch                               | 100                                 |
| 1 1/2 -inch                          | 70-100                              |
| 1-inch                               | 60-90                               |
| 3/4-inch                             | 55-80                               |
| 3/8-inch                             | 20-60                               |
| No. 4                                | 0-25                                |
| No. 8                                | 0-5                                 |
| No. 200                              | 0-3                                 |

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

- A. Excavation shall be performed to the lines and grades indicated. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29 CFR 1926).
- B. Dewatering shall be accomplished in accordance with Section 01525 Temporary Construction Aid and Environmental Controls. The Contractor shall provide and maintain at all times, ample means and devices with which to remove promptly and to properly dispose of all water entering the trench excavation.
- C. The geotextile filter fabric shall be installed in the manner recommended by the manufacturer at the locations shown in the Contract Documents. A minimum of 12-inches of overlap shall be provided at seams. Fabric shall not be exposed to the sun for longer than 72 hours unless the filter fabric has ultraviolet inhibitors.
- D. The toe drainpipe shall be encased in granular filter material and installed in accordance with ASTM D 2321 Recommended Practice and as shown in the Contract Documents. The pipe shall be plugged at the end of each workday, or period of work suspension.

### **3.2 PRELIMINARY CLEANING AND FLUSHING**

- A. The Contractor shall flush the toe drain as the work progresses by a means in accordance with good practice to insure that sand, rocks, or other foreign material are not left in any of the pipelines. If possible, the flushing shall be made with an open pipe end.

\*\*\* END OF SECTION \*\*\*

## SECTION 02712

### STORM DRAINAGE SYSTEM

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. This section covers the work necessary to furnish, excavate, install, backfill and complete storm drain lines at the locations shown in the Contract Documents and as specified herein, to the lines and grades specified.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02222 – Excavation and Backfill for Structures  
B. Section 02712 – Storm Drainage System  
C. Section 02291 – Embankment  
D. Section 02710 – Toe Drain  
E. Section 02617 – Reinforced Concrete Pipe

##### **1.03 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

|             |   |
|-------------|---|
| ASTM C 76   | (1989) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe   |
| ASTM D 422  | Particle-Size Analysis of Soils   |
| ASTM D 698  | Test Method of Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.5-kg) Rammer and 12-inch (305 mm) Drop |
| ASTM D 2487 | Classification of Soils for Engineering Purposes  |
| ASTM D 2922 | Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)  |
| ASTM D3017  | Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)  |

##### **1.04 SUBMITTALS**

- A. The following submittals shall be submitted:
1. Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.

#### **PART 2 – PRODUCTS**

##### **2.01 PIPE BACKFILL**

- A. Selected backfill shall consist of granular material having stones no grater than 2-inches for bedding

concrete pipe and 1/2-inch for bedding polyvinyl chloride pipe. All backfill material shall be free of frozen material, organic material and debris.

- B. Backfill placed above 6-inches over the pipe up to the level of the embankment foundation shall be native material having no stone larger than 4-inches in diameter.

## **2.02 PIPE FOR STORM DRAIN**

- A. Pipe for storm basin detention basin outlet shall be ASTM C76 Class III.

## **2.03 MISCELLANEOUS MATERIALS**

- A. Concrete: Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4,000 psi concrete under Section 03300 – Cast-in-Place Concrete.
- B. Manholes or clean-outs shall conform to Draper City standard drawings. In addition, clean-outs shall be provided with bolt and restraining strap system to withstand an upward surcharge pressure of 1,000 pounds.

## **PART 3 -- EXECUTION**

### **3.01 EXCAVATION**

- A. The toe drainpipe shall be encased in granular filter material and installed in accordance with ASTM D 2321 Recommended Practice and as shown in the Contract Documents. The pipe shall be plugged at the end of each workday, or period of work suspension.

### **3.02 SAFETY**

- A. The Contractor shall flush the toe drain as the work progresses by a means in accordance with good practice to insure that sand, rocks, or other foreign material are not left in any of the pipelines. If possible, the flushing shall be made with an open pipe end.

### **3.03 TRENCH WIDTH**

- A. The bottom of the trench shall have a minimum width equal to the outside diameter of the pipe plus 24-inches or as detailed on the drawings.
- B. The width of the trench shall be ample to permit the pipe to be laid and jointed properly and the backfill to be placed as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing and the handling of special units as necessary.

### **3.04 TRENCH PREPARATION**

- A. Each trench shall be excavated so that the pipe can be laid to the alignment and grade as required. The trench wall shall be so braced that the workmen may work safely and efficiently. All trenches

shall be drained so the pip laying may take place in dewatered conditions.

- B. The trench bottom shall be given a final trim using a string line, laser or other method approved by the City for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Bell holes shall be provided at each joint to permit the joining to be made properly. The trench grade shall permit the pipe spigot to be accurately centered in the preceding-laid pipe joint, without lifting the pipe above the grade and without exceeding the permissible joint deflection.
- C. Pipe shall be bedded a minimum of 6-inches with sand or gravel in unstable ground areas or through rock excavation as directed by the City.

### **3.05 REMOVAL OF WATER**

- A. Dewatering shall be accomplished in accordance with Section 01525 - Temporary Construction Aids and Environmental Controls. The Contractor shall provide and maintain at all times ample means and devices with which to remove promptly and to properly dispose of all water entering the trench excavation.
- B. Water shall be disposed of in a suitable manner without damage to adjacent property or without being a menace to public health and convenience. No water shall be drained into work built or under construction without prior consent of the City.
- C. Dewatering shall be accomplished by well points, sumping, or any other acceptable method, which will insure a dewatered trench. Any dewatering method shall be subject to the approval of the City.

### **3.06 LAYING JOINING CONDUIT**

- A. Laying conduit: Provide proper facilities for lowering pipe sections into place. Dropping pipe will not be permitted. Place each section true to line and gradient in close and true contact with adjacent sections.
- B. Joining Conduit: Use methods of joining conduit sections insuring ends are fully entered and inner surfaces flush and even. The equipment used to force the joints together must be adequate to overcome the gasket pressure involved.

Just prior to joining the pipes, both spigot and bell ends shall be thoroughly cleaned with a wire brush to remove all foreign substances which may have adhered to the bell and spigot surfaces. All dust and dirt shall be removed with a clean rag. A lubricating solution, which is not injurious to the gasket or concrete, such as flax soap, or water glass, shall be liberally applied to the gasket groove and to the entire surface of belling ring. Following this operation, a thin film of lubricant shall be applied to the gasket which shall then be snapped into place in the groove, after which a small diameter smooth steel rod shall be inserted between the gasket and groove and run completely around the gasket to equalize the gasket tension.

In the event any foreign material becomes embedded in the lubricant, or the lubricant becomes contaminated by water or other substance before the joint is started, the area affected shall be re-

cleaned and new lubricant applied.

The pipe being jointed shall be carefully moved into position, line and grade checked and as the spigot end is started into the bell, or the section previously laid, the gasket shall be checked to insure uniform entry into the bell at all points.

### **3.07 PIPELINE TRENCH BACKFILL**

- A. Pipeline trenches shall be backfilled to a level 6-inches above the top of pipe with select native material having stones no greater than 2-inches in diameter for concrete pipe or in accordance with manufacturer's recommendations, whichever is smaller. Such material shall be compacted to 95-percent of maximum Standard Proctor density (ASTM D698) in a maximum of 6-inch lifts.
- B. After the pipe has been installed and approved and the initial portion of backfill has been placed as specified above, backfilling of the remainder of the trench may proceed. Compaction shall be by mechanical tamping in 12-inch maximum lifts. All backfill material shall be free of frozen material, organic material and debris. Backfill placed above 6-inches over the pipe in unimproved areas shall be compacted to 90-percent of the maximum Standard Proctor density (ASTM D 698). No backfill material in the remainder of the trench shall have rocks larger than 4-inches in diameter.

### **3.08 MAINTENANCE OF BACKFILL**

- A. All backfill shall be maintained in satisfactory condition, and all places showing signs of settlement shall be filled and maintained during the life of the contract and for a period of one year following the day of final acceptance of all work performed under the Contract Documents. When the Contractor is notified by the City or the Developer that any backfill is hazardous, the Contractor shall correct such hazardous condition at once. Any utility, road and/or parking surfacing damage by such settlement shall be repaired by the Contractor to the satisfaction of the Developer and City. In addition, the Contractor shall be responsible for the cost of such repair of all claims for damage filed with the Court; actions brought against the said Developer or City, for, and on account of such damage.

### **3.09 FINISH GRADING, CLEANUP**

- A. The Contractor shall grade the trench line to a smooth grade to affect a neat and workmanlike appearance of the trench line.
- B. All tools, equipment and temporary structures shall be removed. The Contractor shall remove all excess dirt and rubbish from the site.

### **3.10 COMPACTION TESTS**

- A. Field density tests shall be made in accordance with ASTM D 698.
- B. The cost of field density tests will be borne by the Contractor.

\*\*\* END OF SECTION \*\*\*

## **SECTION 02750**

### **SANITARY AND STORM DRAINAGE SYSTEM TESTING**

#### **PART 1 -- GENERAL**

##### **1.01 THE REQUIREMENT**

- A. The CONTRACTOR shall perform all pipeline flushing and testing, complete, for sanitary sewerage and storm drainage system piping as specified herein and in accordance with the requirements of the Contract Documents.
- B. The CONTRACTOR shall be responsible for conveying test water from the Owner-designated source to the point of usage and also for disposal, as required, of water used in the testing operations.

##### **1.02 CONTRACTOR SUBMITTALS**

- A. The CONTRACTOR shall submit minimum 48-hour advance written notice of its proposed testing schedule for review and concurrence of the ENGINEER. The CONTRACTOR's proposed plans for water conveyance, control, and disposal shall also be submitted in writing.

#### **PART 2 -- PRODUCTS**

##### **2.01 MATERIALS REQUIREMENTS**

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the CONTRACTOR subject to the ENGINEER's review. No materials shall be used which would be injurious to pipeline structure and future function.

#### **PART 3 -- EXECUTION**

##### **3.01 GENERAL**

- A. Unless otherwise provided herein, water for testing will be furnished by the OWNER; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-designated source to the points of use.
- B. Release of water from pipelines, after testing has been completed, shall be performed as reviewed by the ENGINEER.
- C. All testing operations shall be performed in the presence of the ENGINEER.

### 3.02 TESTING OF PIPING

- A. General: All gravity sewer pipes and service laterals shall be tested for exfiltration and/or infiltration and deflection as specified herein. All manholes shall be tested for leakage as required herein. Manholes shall be tested prior to backfill placement, whereas all pipe shall be backfilled prior to testing. Any pipe, lateral or manhole found to be defective shall be repaired or replaced to the satisfaction of the ENGINEER.
- B. Leakage Tests: All gravity sewer pipes shall be tested for leakage by one of the following three test methods as directed by the ENGINEER and following the specific procedures outlined in the referenced sections of the "Standard Specification for Public Works Construction" (SSPWC) 1985 edition:
1. Water Exfiltration Test      Section 306-1.4.2
  2. Water Infiltration Tes      Section 306-1.4.3
  3. Air Pressure Test            Section 306-1.4.4
- C. Deflection Test: All flexible and semi-rigid pipe shall be tested for deflection, joint displacement, or other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to any resurfacing. The mandrel test shall comply with the specific procedures required in Section 306-1.4.6 of the SSPWC, except for the additional provision that the mandrel shall be a full circle, solid cylinder, or a rigid, non-adjustable, odd-numbered leg (9 leg minimum) steel cylinder, approved by the ENGINEER as to design and manufacture.
- D. Manhole Leakage: Manholes shall be tested for leakage after installation, but prior to being backfilled. All pipes entering the manhole shall be sealed at a point outside the manhole walls so as to include testing of the pipe-manhole joints. The manhole shall be filled with water to a level 2 inches below the top of the frame. The water shall be allowed to equilibrate for 24 hours and then the level should be readjusted and marked. The water-filled manhole shall be allowed to sit for 3 days, after which the water level shall be measured. The water loss, adjusted for evaporative loss, shall not exceed 0.5 percent of the total volume. The exterior of the manhole shall be inspected daily during this period for visible evidence of leakage. Visible moisture, sweating, or beads of water on the exterior of the manhole shall not be considered leakage, but any water running across the surface will be considered leakage and shall be repaired to the satisfaction of the ENGINEER regardless of the volume of water lost.

\*\*\* END OF SECTION \*\*\*

## SECTION 02771

### HIGH DENSITY POLYETHYLENE LINER

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. This section covers the manufacture, supply, and installation of the 60 mil HDPE liner and SLT HDPE PolyLock materials.

##### **1.02 RELATED WORK AND REFERENCES**

- A. Section 02222 - Excavation and Backfill for Structures  
B. Section 02224 - Embankment  
C. Section 02710 - Toe Drain  
D. Section 03300 - Cast-In-Place Concrete

##### **1.03 REFERENCES**

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society of Testing and Materials (ASTM)  
ASTM D 638 Standard Test Method for Tensile Properties of Plastics  
ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers By Impact  
ASTM D 792 Standard Test Method for Specific Gravity and Density of Plastics by Displacement  
ASTM D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting  
ASTM D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature  
ASTM D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastomer  
ASTM D 1505 Test Method for Density of Plastic by the Density-Gradient Technique  
ASTM D 1593 Specification for Nonrigid Vinyl Chloride Plastic Sheeting  
ASTM D 1603 Test Method for Carbon Black in Olefin Plastics  
ASTM D 1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics  
ASTM D 3015 Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds  
ASTM D 4437 Practice for Determining Integrity of Field Seams Using Joining Flexible Polymeric Sheet Geomembranes
- C. Federal Test Method Standards  
101C Puncture Resistance.
- D. National Sanitation Foundation (NSF)

#### **1.04 DEFINITIONS**

- A. Batch: A quantity of resin usually the capacity of one rail car, used in the fabrication of high density polyethylene geomembrane roll. The finished roll will be identified by a roll number corresponding to the resin batch used.
- B. Bridging: When the geosynthetic is not in contact with the underlying material.
- C. Film Tearing Bond (FTB): A failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation of the bonded area.
- D. Geomembrane Manufacturer: The party responsible for producing geomembrane rolls from resin, and for providing the materials warranty upon completion of the project.
- E. Geosynthetics Quality Assurance Laboratory (Testing Laboratory): Party responsible for conducting laboratory tests on samples of geosynthetics obtained at the site.
- F. Geomembrane Subgrade: Material surface upon which geomembrane will be placed.
- G. Installer: The party responsible for field handling, transporting, storing, deploying, seaming, temporary restraining and anchoring (against wind) and other applied forces, and installing the geomembrane. The Installer is also the party responsible for testing, observation and reporting, and for providing the Installer's Warranty upon completion of the project.
- H. Panel: The unit area of geomembrane that will be seamed in the field. If geomembrane is not fabricated into panels in the factory, a panel is identified as a roll or portion of a roll that is larger than five (5) lineal feet.
- I. Quality Assurance (QA): The manufacturer's method of assuring quality in product manufacturing

#### **1.05 LINER MANUFACTURER QUALIFICATIONS**

- A. To demonstrate an ability to manufacture geomembrane sheeting, the HDPE Manufacturer shall submit to the engineer a list of at least five previous projects for which the manufacturer provided HDPE liner. For each project, the following information shall be provided; name and purpose of project, location, date, name of client, client contact, client phone number, installer, thickness of liner, and surface area. The above list shall be provided to the Engineer at the time of Bid Submittal.
- B. The following is a partial list of manufacturer for HDPE liner products
  - 1. SLT North America, Inc.  
200 South Trade Center Parkway  
Conroe, Texas 77385  
1-800-231-1298
  - 2. Gundle Lining Systems, Inc.  
19103 Gundle Road  
Huston, Texas 77073  
1-800-435-2008

3. Polyflex, Inc.  
200 West Marshall Drive  
Grand Prairie, Texas 75051  
1-800-527-3322
4. National Seal Company  
1245 Corporate Blvd.  
Aurora, Illinois 60504  
1-708-898-1161

#### **1.06 LINER INSTALLER QUALIFICATIONS**

- A. The geomembrane Installer shall be trained and qualified to install the type of HDPE geomembrane to be used for this project. The installer shall be an approved and/or licensed installer of the HDPE Manufacturer. A copy of the Manufacturer's approval letter or the Installer's license shall be submitted to the Engineer at the time of Bid.
- B. The Installer shall submit to the Engineer at the time of Bid a list of at least five previous installations. For each installation the following information shall be provided; name and purpose of project, location, date, name of client, client contact, client phone number, installer, thickness of liner, and surface area.
- C. To demonstrate the quality of the Installer's warranty, the Installer shall provide references for three previous projects that required warranty work. The list shall include the client's name, a client contact, and the client's contact phone number. This list shall be presented to the Engineer at the time of Bid.
- D. The Installer shall be approved by the Engineer prior to installation of any geomembrane materials.

#### **1.07 LINER MANUFACTURER SUBMITTALS**

- A. Resin Data:
  1. Manufacturers published material properties and QA specification requirements for resin materials.
  2. Quality Control/Quality Assurance Certificates shall be submitted for each lot of resin issued by the resin Supplier for the specific material for this project, and shall be submitted two (2) weeks prior to delivery of the geomembrane.
  3. Certification that all resin is from the same supplier and meets the manufacturers published material property and QA specification requirements as well as the specification requirements referenced herein, shall be submitted two (2) weeks prior to installation of any geomembrane.
- B. Geomembrane Rolls:
  1. Manufacturers published material properties and QA specification requirements for geomembrane products.
  2. One HDPE Roll Quality Control Certificate shall be provided if the rolls of material supplied to the project were produced consecutively. This certificate shall be supplied only for the individual HDPE rolls sampled and tested by the Manufacturer or his representative. An individual Quality Control Certificate shall be provided for each roll of HDPE material

provided to the project, which was not produced consecutively within a lot of twenty-five thousand (25,000) square feet. Quality Control Certificates shall be submitted two (2) weeks prior to installation of geomembrane and shall state that the geomembrane meets manufacturers published material properties and QA specification requirements as well as the specification requirements contained herein. The certificates shall include:

- a. Thickness
  - b. Tensile Strength at Yield
  - c. Tensile Strength at Break
  - d. Percent Elongation at Yield
  - e. Percent Elongation at Break
  - f. Carbon Black Content
3. HDPE material shall not be accepted and/or incorporated into the project without the approved quality control documentation.
  4. Certification stating that all geosynthetic rolls are furnished by one manufacturer and shall be submitted two (2) weeks prior to installation of geomembrane.
  5. Certification correlating resin to the individual HDPE rolls and extruded materials shall be submitted two (2) weeks prior to installation of geomembrane.
  6. Statement certifying that no reclaimed polymer is added to resin (product run may be recycled) shall be submitted two (2) weeks prior to installation of geomembrane.

C. Extruded Rods or Beads:

1. Statement certifying that all extrudate is from one Manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the geomembrane rolls.

## **1.8 LINER INSTALLER SUBMITTALS**

A. Prior to Commencement of Work: The following pre-construction submittals shall be received by the Engineer a minimum of two (2) weeks prior to commencement of geomembrane installation.

1. Provide resumes of supervisor / field engineer, master welder, and all personnel performing field seaming operations a minimum of three (3) weeks prior to installation of the geomembrane.
  - a. Installation supervisor / field engineer shall have worked in a similar capacity on at least 2 jobs.
  - b. The master welder shall have completed a minimum of 5,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this project.
  - c. Other welding technicians shall have installed a minimum of 1,000,000 square feet of geomembrane.
  - d. Installation personnel not meeting the above mentioned pre-qualifications may be used with the written authorization of the Engineer.
  - e. Statement from the manufacturer certifying that the HDPE liner material can be welded to the PolyLock material and provide welds of equivalent integrity to the welds between HDPE liner panels.

**B. Submittals by Installer During Project:**

1. Daily Quality Control documentation shall be legibly recorded by the Installer during installation of the HDPE and shall be submitted to the Engineer on a daily basis. The information to be recorded and provided to the Engineer shall include:
  - a. INSTALLER'S DAILY ACTIVITIES – List all liner placement activities and record defects discovered during handling and deployment of geosynthetics. Discuss problems encountered during installation and resolutions of the problems.
  - b. HDPE LINER INSTALLATION PRE-WELD TEST SEAM DATA – Include the time, welder's name, machine number, extrudate / tip temperature (°F), type of test, results and comments.
  - c. ROLL INSPECTION – Include roll number, inspection date of the deployed roll, results and comments.
  - d. SEAM INSPECTION – Include seam number and location, date welded, observed defects, corrective action and comments.
  - e. EXTRUSION WELD – Include seam number and location (or patch / cap number and location), date welded, welding machine number, welding technician and comments.
  - f. HOT WEDGE WELD – Include seam number and location (or patch / cap number and location), date welded, welding machine number, welding technician and comments.
  - g. NON-DESTRUCTIVE TESTING FOR EXTRUSION WELD (VACUUM TEST) – Include seam / panel number and location (or patch / cap number and location), test date, test results, corrective action and comments.
  - h. NON-DESTRUCTIVE TESTING FOR HOT WEDGE WELD (PRESSURIZED AIR CHANNEL TEST) – Include seam / panel number and location (or patch / cap number and location), test date, test results, corrective action and comments.
  - i. HDPE LINER – DESTRUCTIVE SEAM TESTING – Include sample number; seam number; location; weld date; machine number; type of test; test date and test results (for both field and lab testing), corrective actions and comments.
  - j. SUBGRADE SURFACE ACCEPTANCE – To be documented for each area to be covered by the lining system. Commencement of installation shall indicate Installer's acceptance and approval of existing surface conditions

**C. Submittals by Installer Upon Completion of Project:**

1. A complete copy of all quality control and quality assurance testing performed during installation of the geosynthetics.

**1.08 DELIVERY, STORAGE AND HANDLING**

- A. Transportation: Transportation of the geomembrane rolls or panels shall be the responsibility of the liner Installer and / or Manufacturer.
- B. Delivery: Off-loading and storage of the geomembrane shall be the responsibility of the liner Installer. Off-loading of all geomembrane materials shall be performed in the presence of the engineer's representative. A complete inventory of materials will be performed by the Installer upon their receipt at the construction site, at which time all damaged rolls, and rolls which are not properly labeled will be separated from the undamaged rolls. Damage shall include, but shall not be limited to physical damage to the material resulting directly from equipment during the off-loading, site transportation, deployment processes, or indirectly from leakage or spillage of any fluids on the material. The installer shall be responsible for the replacement of damaged or

unacceptable materials at no additional cost.

- C. Storage of Materials: the Owner shall provide a storage area on site. The storage of HDPE materials shall be the complete responsibility of the Installer. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud mechanical abrasions, excessive heat or other damage. Rolls of HDPE materials shall be stored on a regular, flat, rigid prepared surface (not wooden pallets). The Installer shall be responsible for any damages to the materials resulting from improper storage.
- D. On Site Handling: The Installer shall use appropriate handling equipment to load, move or deploy geomembrane rolls. The Installer shall assume all responsibility to insure that all local, state rules and regulations are followed.
- E. Damaged Geomembrane: Damaged geomembrane shall be repaired, if possible, in accordance with these specifications, or shall be replaced at no cost to the Owner.

## **1.09 QUALITY ASSURANCE**

- A. The owner may engage and pay for the services of a Quality Assurance Consultant to observe geomembrane installation.

## **1.11 WARRANTY**

- A. Upon acceptable completion of the Work, warranties shall be provided and transferred to the Owner by both the manufacturer and the Installer, which shall warrant the quality of materials and workmanship for a minimum period of twenty (20) years. Without limiting the provisions of the Contract, the warranties shall warrant that:
  - 1. The HDPE materials supplied are suitable for the environmental conditions at the site and the service conditions as described in this specification.
  - 2. The HDPE material supplied meets or exceeds all published specifications as referenced by this performance specification.
  - 3. The HDPE materials supplied are free of defects in materials and workmanship.
  - 4. The Manufacturer and Installer warrant to repair and /or replace, without additional payments, all defects in the material and installation workmanship.
  - 5. The Installer warrants to repair, without additional payment, all detected leaks in seams (manufactured or field joined).

## **PART 2 -- PRODUCTS**

### **2.01 MATERIALS**

- A. HDPE Resin: The HDPE resin shall be manufactured of new, first quality resin and shall be compounded and manufactured specifically for producing HDPE geomembrane.
  - 1. Resin types shall not be mixed.
  - 2. Every batch of resin shall be sampled, tested, and certified by the Resin Manufacturer to have a minimum of two (2) weeks prior to installation of geomembrane.
  - 3. Resin Quality control Certificates shall be provided to the engineer a minimum of two (2)

weeks prior to installation of geomembrane.

4. The resin used in manufacturing the material for extrusion welding shall be the same as used in manufacturing the geomembrane.

#### B. HDPE Liner

1. HDPE liner shall be manufactured of new, first quality, high-density polyethylene materials.
2. The HDPE liner shall contain two to three (2-3) percent carbon black for ultra violet resistance.
3. Geomembrane shall be provided in rolls (folded geomembrane shall not be permitted).
4. The Surface of the HDPE liner shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, thin spots, blisters, undispersed raw materials, or any contamination by foreign matter.
5. Each roll of HDPE liner shall be externally labeled or tagged to provide product identification sufficient for field identification as well as inventory and quality control purposes. Each roll shall be labeled with the name of manufacturer, roll number, batch or lot number, physical dimensions (length and width) and the material thickness. Any roll of HDPE liner from which the labeling has been removed or has become illegible, shall not be used, but shall be removed from the site and replaced at the expense of the Installer.
6. The HDPE liner shall be sampled, tested, and certified by the manufacturer for allowable thickness, carbon black content (ASTMD1603), carbon black dispersion (A / A-1 / 2, ASTM D3015), melt index (ASTM D1238 E), density (0.94 min., ASTM D1505), tensile strength at yield (ASTM D638 Type IV dumbbell @ 2ipm), tensile strength at break (ASTM D638 type IV dumbbell @ 2ipm), elongation at yield (ASTM D638 Type IV dumbbell @ 2imp), and dimensional stability (212 °F for 1 hour, ASTM D1204).

### **2.2 EXTRUDATE ROD OR BEAD**

- A. Extrudate rod or bead shall be made from same resin as the geomembrane.
- B. Additives shall be thoroughly dispersed.
- C. All material shall be free of contamination, moisture or foreign matter.
- D. Extrudate rod or bead shall not be used until all of the requested documentation has been submitted to and approved by the Engineer.

### **2.03 POLYLOCK**

- A. PolyLock manufactured by SLT North America, Inc. (phone (800) 231-1298) shall be installed in all concrete structures, which contact the HDPE liner.

### **2.04 EQUIPMENT**

- A. Welding equipment and accessories shall meet the following requirements.
  1. Equipped with gauges showing temperatures in apparatus (extrusion welder) or at wedge (wedge welder)
  2. Maintain adequate number of welding apparatuses to avoid delaying work.
  3. Use power source capable of providing constant voltage under combined line load.
  4. Provide protective pad large enough to catch spilled fuel under electric generator.

- B. Provide tensiometer capable of quantitatively measuring geomembrane seam strength of field specimens.
  - 1. Equipped with internal circuit to simulate load cell under load to verify calibration.
  - 2. Test specimens shall be cut using a coupon die cutter.

### **PART 3 -- EXECUTION**

#### **3.01 PLACEMENT AND COMPACTION OF THE EMBANKMENT MATERIAL**

- A. The Contractor will perform placement and compaction of the embankment material. Upon acceptance of the embankment by the Engineer, the liner Installer may commence with construction of the HDPE liner.

#### **3.02 TOPSOIL PLACEMENT**

- A. The Contractor shall be responsible to place and compact acceptable top soil over the HDPE liner as shown on the construction drawings.

#### **3.03 PRE-WELD SEAMS**

- A. Pre-weld seams shall be made on geomembrane samples to verify welding equipment and performance seaming conditions. Pre-weld seams shall be made at the commencement of welding in both the morning and afternoon.
- B. Additional pre-weld seams shall also be required whenever the welding apparatus has been turned off for a period of time exceeding fifteen minutes, or due to drastic changes in weather conditions as determined by the Engineer.
- C. In addition, anytime a welder uses a welding machine that he has not used within two (2) days of welding, then in addition to the pre-weld seams, two (2) coupons shall also be cut from the first one hundred (100) feet of welding performed by the welder and shall be tested in peel and shear as part of these specifications.
- E. Pre-welds seams shall be performed for each technician-welding apparatus combination.
- F. The minimum overlap for all pre-welded seams shall be three (3) inches.
- G. Pre-weld seams shall be a minimum of ten (10) feet long for fusion welding and minimum of three (3) feet long for extrusion welding with the seam centered lengthwise. The Installer shall cut a minimum of two specimens, one from near each end of the pre-weld seam. The specimens shall be cut to a 1-inch width. Each specimen shall be tested for peel adhesion and then for bonded seam strength.
- H. The Installer shall test pre-weld seams.
- I. A pre-weld specimen shall pass when the following results are achieved for both peel and shear test.

1. The break, when peel testing, occurs in the liner material itself, not through peel separation. In the case of dual-track fusion welding, if either track fails through the weld, the pre-weld seam is considered to fail
  2. The break is ductile.
  3. The peel strength shall be based upon Film Tearing Bond criteria, to demonstrate that a homogenous bond has fused the sheets together.
  4. The shear strength is not less than 90% of the specified tensile yield strength of the geomembrane.
- J. In the event that any of the pre-weld seams fail, the entire pre-weld seam procedure shall be repeated after the appropriate adjustments to the welding apparatus have been made or the operator has made appropriate modifications. If a second pre-weld seam fails, the welding apparatus and / or the operator shall be rejected by the Engineer and shall not be used for seaming until such time as the deficiencies are resolved and verification of the resolution is provided by providing two (2) consecutive pre-weld samples which have passing results.
- K. The liner Installer shall be responsible to monitor all pre-weld seaming and to record the results of all pre-weld seaming on a daily basis. A copy of all pre-weld seaming results shall be provided to the Engineer on a daily basis, and upon completion of pre-weld seaming.
- L. No welding equipment or welder shall be allowed to perform production welds or repairs until they have acceptably completed a pre-weld seam as indicated above.

### **3.04 INSTALLATION**

#### **A. Deployment**

1. Prior to deployment, the Installer shall inspect each roll of geomembrane to verify that the roll has a valid Quality Control Certificate, that the Engineer has previously approved it, and that the liner has the proper liner thickness. Geomembrane liner thickness shall be measured at five random points across the leading edge of the roll. The liner thickness shall be measured using a micrometer or other approved measuring device. Material, which fails to meet these criteria, shall not be deployed, but shall be removed from the project area at the contractor's expense.
2. Panels shall be positioned to minimize handling.
3. The Installer shall visually inspect the geomembrane during deployment for imperfections and mark faulty or suspected areas for repair.
4. The Installer shall not deploy more liner in one day than can be welded and properly secured during the same day.
5. After deployment, but prior to seaming, the Installer shall inspect each panel for damage caused by placement operations and / or wind. Damaged sections shall be marked and repaired, or removed and replaced by the Installer at no additional cost to the Owner.

#### **B. Method of Placement**

1. The liner Installer shall not be allowed to use equipment on the finished geomembrane subgrade during deployment and installation of the HDPE liner that will damage or alter the integrity of the subgrade. Damage caused to the subgrade by the Contractor, or his representatives, shall be repaired to the original specifications at the Contractor's expense.
2. Vehicular traffic shall not be allowed directly on the geomembrane.

3. The method used to unroll the HDPE liner shall not cause scratches or crimps in the geomembrane liner and shall not damage the support soil or underlying geosynthetics.
4. Personnel walking on the geomembrane shall not engage in activities or wear shoes that could damage the geomembrane.
5. Smoking shall not be permitted on the geomembrane.
6. The method used to place the HDPE liner shall minimize wrinkles and waves.
7. The liner Installer shall be responsible to provide adequate loading (e.g., sand bags or similar items that will not damage the HDPE liner) on the liner and along all exposed edges of the geomembrane liner to prevent uplift by the wind. Any damage to the geomembrane liner caused by wind or other weather related causes shall be repaired by the liner Installer, at the Contractor's expense.
8. Any damage caused by temporary loading on the HDPE liner or by permanent anchorage shall be repaired by and at the expense of the liner Installer.
9. The liner Installer shall recognize that the liner shall not be considered as permanently anchored until all liner trenches have been completely backfilled and the entire length of the HDPE liner has been covered with topsoil.
10. Folds in the geomembrane shall be removed at the time of deployment, and prior to seaming.

C. Panel Identification

1. Each panel shall be assigned a simple and logical identifying code, which indicates the layer and sequence of deployment.
2. The Installer shall be responsible for labeling each panel as it is deployed. The labels shall include, at a minimum, panel number, roll number from which the panel was obtained, and date the panel was deployed. Engineer reserves the right to refuse any panel, portion of panel, or roll, which is not correctly labeled.
3. The Installer shall be responsible to perform and document a panel inspection for each panel. The documentation shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work

### **3.05 FIELD SEAMING**

A. Orientation and Location: Procedures for seam orientation and location are as follows:

1. The number of seams shall be minimized.
2. The minimum overlap before seaming shall be three (3) inches. The Installer shall indicate the lap by making reference marks prior to seaming at an interval not exceeding 50-feet.
3. Panels shall be placed such that the overlap of upslope panels overlies those down slope.
4. Seaming shall follow as close behind deployment as practical.
5. The liner Installer shall be responsible to inspect and document all seaming on a daily basis. The documentation shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work.

B. Seaming Methods

1. Field seaming shall be performed using fusion and / or extrusion welding methods in accordance with the manufacturers recommendations.
2. Areas to be seamed shall be clean and free of grease, moisture, dust, debris, dirt, or any marking on the geomembrane.
3. Where required, a hard surface shall be placed directly under the seam overlap to achieve proper support.

4. The Installer shall protect the integrity of the HDPE liner during all seaming operations. HDPE liner which is damaged as a result of improper temporary bonding, seaming, or associated work shall be removed and / or repaired at the expense of the liner Installer.
5. The liner Installer shall be responsible to inspect and document seaming on a daily basis. The documentation shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work.

**C. Extrusion Welding**

1. Each welding unit shall include an electronic controller, which displays the temperature of the extrudate at the nozzle.
2. The minimum overlap before seaming shall be three (3) inches.
3. Hot-air bond adjacent panels together using procedures that do not damage geomembrane prior to seaming.
4. If the welding unit has not been used for more than 15 minutes, the unit shall be run for a minimum of two (2) minutes in order to purge the welding apparatus of heat-degraded extrudate before welding resumes.
5. Extrudate purged from the welding apparatus shall not be placed on liner subgrade.
6. The exposed edges of HDPE liner shall be cleaned of oxidation using a disc grinder or equivalent. Grinding shall be completed no more than fifteen (15) minutes prior to seaming.
7. Bevel top edges of geomembrane before extrusion welding.
8. Exposed grinding marks adjacent to an extrusion weld shall be minimized. In no instance shall exposed grinding marks extend more than ¼ inch from the seamed area. The Installer shall be required to cover all abraded areas with extrudate.
9. Grind ends of all seams, which are more than five (5) minutes old, when restarting welding.
10. The liner Installer shall be responsible to inspect and document all extrusion welding on a daily basis. The documentation shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work.

**3.06 WEATHER CONDITIONS**

- A. The normal required weather conditions for seaming are as follows:
1. Seaming of the HDPE liner shall not be performed at ambient temperatures below forty (40) or above ninety-five (95) degrees Fahrenheit, unless other limits are approved, in writing, by the Engineer. The Engineer may require that additional pre-weld tests be performed by the Installer to verify that seaming conditions are adequate. The ambient temperature shall be measured at a point six (6) inches above the HDPE liner being deployed.
  2. Geomembrane seaming shall not be performed during precipitation events or during period of excessive humidity. In addition, welding shall not take place in an area of ponded water. Conditions of excessive humidity shall be determined based on welding performance and results.
  3. Geomembrane seaming shall not be performed during excessive winds, unless wind barriers are provided.

**3.07 NON-DESTRUCTIVE FIELD TESTING**

- A. All field seams shall be non-destructively tested and observed by the Installer over their full length using a vacuum test unit, air pressure test, or other method approved by the Engineer. Non-destructive testing shall be carried out as the seaming work progresses, not at the completion of

the seaming. Seams, which cannot be non-destructively tested, using either the vacuum test unit or air pressure test, may be non-destructively tested using the electric spark test method when approved by the Engineer.

B. Vacuum Testing: All seams welded using the extrusion process shall be tested using the Vacuum Test Method.

1. The equipment shall consist of the following:
  - a. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a porthole or valve assembly, and vacuum gauge.
  - b. A vacuum pump assembly equipped with pressure control.
  - c. A rubber pressure / vacuum hose with fittings and connections.
  - d. A soapy solution and an applicator.
2. Test procedures:
  - a. All areas tested shall be prewetted with a soapy solution immediately prior to testing.
  - b. Place vacuum box over the wetted seam area.
  - c. Ensure that a leak-tight seal is created.
  - d. Apply a minimum vacuum pressure of 5-psi gauge and examine the geomembrane through the viewing window for a minimum of fifteen (15) seconds.
  - e. All areas where leaks are detected shall be marked by the Installer, repaired, and retested at the expense of the Installer.
  - f. The liner Installer shall be responsible to inspect and document all non-destructive vacuum testing on a daily basis. The documentation shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work.

C. Air Channel Pressure Testing: Air channel pressure test shall be applicable for double track fusion welded seams.

1. The equipment shall consist of the following:
  - a. An air pump equipped with a pressure gauge capable of generating and sustaining pressure between twenty 24 and 30-psi
  - b. A rubber hose with fittings and connections.
  - c. A sharp, hollow needle, or other approved pressure feed device.
2. Test Procedures
  - a. Seal both ends of seam to be tested, insert air needle into the air channel and pressurize the air channel to between 27 and 30 phi.
  - b. Allow air channel pressure to stabilize for a period of two (2) minutes prior to performing the test. The test shall then be continued for a minimum of five (5) minutes.
  - c. If the loss of pressure exceeds 3-psi or does not stabilize, the source of the leak shall be located, the necessary repairs made, and the seam shall be retested in accordance with this specification.
  - d. Puncture the opposite end of seam to release air. If blockage is present, the blockage shall be located and the seam may be tested on either side of the blockage. The blocked area shall be repaired and tested using the vacuum test method.
  - e. If the seam strength is not adequate, the edge of the loose flap of the upper sheet (which extends beyond the outer track) shall be extrusion fillet welded to the bottom sheet. The repaired seam shall then be non-destructively tested using the Vacuum Test Method.

- f. The liner Installer shall be responsible to inspect and document all non-destructive air-channel testing on a daily basis. The completed form shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work.
- D. Electric Spark Testing: This method shall only be applied to extrusion-welded seams that cannot be accessed by the vacuum box.
- 1. The equipment shall consist of the following:
    - a. Eighteen (18) gauge bar copper wire.
    - b. High voltage spark tester capable of operating in a range of 10 to 55 KV.
  - 2. Test Procedures:
    - a. Prepare the seam to be extrusion welded.
    - b. Insert an 18 gauge bare copper wire in the seam area, where it will appear at the bottom of the weld after the seam is welded, with one end of the wire left exposed.
    - c. Extrusion weld the seam.
    - d. After the weld has cooled, connect the exposed end of the copper wire to the ground terminal on the high voltage spark tester.
    - e. Turn the spark tester on and adjust the output voltage control to minimum. Hold the test probe on the spark tester near the exposed end of the copper wire and increase the output voltage until a spark can be obtained at least twice as long as the thickness of the material to be tested (or twice as thick as the weld).
    - f. Move the probe slowly along the length of the welded seam. Document and mark on the HDPE liner adjacent to the weld locations where sparking is observed, indicating the presence of leaks.
    - g. After testing of the seam is complete, verify that the length of the spark to the exposed end of the copper wire is still adequate before turning the machine off. If the spark is not adequate, readjust the voltage and retest the seam.
    - h. All areas where leaks are detected shall be marked by the Installer, repaired, and retested at the expense of the Installer.
    - i. The liner Installer shall be responsible to inspect and document all non-destructive vacuum testing on a daily basis. The documentation shall be provided to the Engineer on a daily basis, and within 24 hours of completion of the work.

### **3.8 DESTRUCTIVE SEAM TESTING**

#### **A. Location and Frequency of Testing**

- 1. Destructive test sample locations shall be identified by the Engineer or his representative and cut from the HDPE liner by the Installer as the seaming progresses. Locations may be prompted by appearance of excess heating, contamination, offset welds, or suspected defects. Engineer shall not be required to notify Installer in advance of selecting locations where seam samples will be taken. Destructive samples shall not be cut from high stress areas or from welds to the PolyLock material.
- 2. The Installer shall provide to the Engineer destructive test samples at the following frequency:
  - a. Two (2) samples from the first 400 feet for each welder / apparatus combination used that day.
  - b. One (1) additional destructive test sample shall also be obtained if the welder or welding apparatus are changed.
  - c. One (1) additional destructive test sample shall be obtained for every additional 400 feet welded by a welder / apparatus combination.

3. The testing frequency may increase at the discretion of the Engineer.
- B. All destructive test samples shall be marked by the Installer with their sample number, roll and panel number, seam number, name of welder, welding machine number, and date of weld.
- C. Size of Samples: Destructive test samples shall be a minimum of thirty-eight (36) inches long by twelve (12) inches wide. A one-inch wide specimen shall be cut from each end of the seam destructive sample, and be tested in shear and in peel by the Installer in the field. If the destructive seam test sample passes the preliminary field-testing, then the remaining sample shall be divided into two portions for distribution as follows:
  1. One portion for the Installers laboratory
  2. One portion for the Owner for archive storage.

Failure of any of the test samples (laboratory or field) shall be reason to fail the entire destructive test sample. The liner Installer shall be required to repair the affected seams at no additional cost.

- D. Installer shall immediately repair all holes in the geomembrane resulting from destructive sampling in accordance with these specifications.
- E. The liner Installer shall be responsible to inspect and document all destructive seam testing. The documentation shall be updated continually and provided to the Engineer throughout the duration of the job and upon request. A finalized copy shall also be forwarded to the Engineer at the completion of the project.
- F. Laboratory Testing by Geosynthetic Installer Quality Assurance Laboratory
  1. Test sample in peel and shear (ASTM D4437). The peel test criterion shall be the film tearing bond and the shear test criterion shall be 90% of the minimum tensile strength at yield for the sheet.
  2. Select specimens for each sample alternately for testing (i.e. peel, shear, peel, shear, etc.)
  3. Provide test results no more than 48 hours after cutting the destructive samples from the installed geosynthetics.
  4. In the case of dual-track fusion welding the seam to be tested in peel is the inner seam (i.e. the seam which cannot be seen from the top surface of the liner).
  5. All laboratory testing of geosynthetics by Installer's laboratory shall be the responsibility of the Contractor, and shall be provided at no additional expense to the Owner.

G. Failed Seam Procedure

1. The Installer may choose to cap the entire days production for the technician and welding apparatus rather than perform additional destructive testing. Under this case, the cap becomes the primary seam and the procedures for destructive testing may apply at the discretion of the Engineer.
2. If the Installer chooses not to cap the technicians entire days production, then the following procedure shall be used when there is a destructive test failure.
  - a. The Installer shall trace the weld in both directions from the location of the failed test at least 10 feet, or to where the seam ends. If the seam is less than 10 feet long, the Installer shall check the next seam welded, either direction, by the same welding device and technician.

- b. Obtain a one-inch sample at both locations for field-testing by the Installer.
  - c. If the field samples fail, then additional one-inch field samples shall be taken at a distance away from the failure, as directed by the Engineer. This process is repeated as necessary until the extent of the failed seam is identified.
  - d. When the extent of the defective seam has been identified, based upon field-testing, laboratory samples shall be taken as specified in paragraph 3.7 of these specifications.
  - e. If any of the laboratory samples fail, the process shall be repeated to determine the extent of the defective seam.
3. Once the extent of the defective seam is identified, and verified by laboratory results, the defective seam shall be repaired using one of the following methods:
    - a. Each sample hole and destructive test sample hole shall be individually capped and non-destructively tested, after which the entire defective seam, including patches, shall be capped and non-destructively tested, or;
    - b. Each sample hole and destructive test sample hole shall be individually patched and non-destructively tested, after which the entire length of defective seam, between holes previously patched and vacuum tested, shall be capped and non-destructively tested, or;
    - c. If the seam was welded using the Hot-Wedge method, each sample hole and destructive test sample hole shall be individually patched and non-destructively tested. The loose flap of the upper sheet (which extends beyond the out track) shall then be extrusion welded to the bottom sheet over the entire length of the defective seam, between holes previously patched, and non-destructively tested.
  4. All defective seam repairs may be destructively tested in accordance with these specifications at the discretion of the Engineer.

### **3.09 REPAIR PROCEDUES**

- A. All seams and non-seam areas of the HDPE liner shall be observed for defects, holes, blisters, undispersed raw materials, improper welds, overgrinds, etc. The liner Installer shall have the option to either non-destructively test, or repair and then non-destructively test all suspected defect locations. Each location that fails the non-destructive testing shall be marked by the Installer, repaired, and retested in accordance with these specifications.
- B. The liner Installer shall remove damaged geomembrane and replace with acceptable geomembrane materials, if damage cannot be satisfactorily repaired in accordance with these specifications, at no additional cost to the Owner.
- C. The Installer shall repair any portion of the geomembrane exhibiting or failing a destructive or non-destructive test. Installer shall be responsible for repair of damaged or defective areas. Procedures available include:
  1. Patching: Blisters, pinholes, holes, tears, contamination by foreign matter, etc. shall be repaired by patching the affected area. Patches shall be round or oval in shape, made of the same HDPE liner as the liner to be repaired, and extend a minimum of six (6) inches beyond the edge of the defect. All patches shall have their top edge beveled with an angle grinder prior to placement of the patch, and shall be continuously welded.
  2. Abrading and re-welding: Extrusion spot welding shall be used to repair undispersed raw materials, minor localized flaws, where geomembrane thickness has been reduced by more than four (4) mills by over grinding, and seam sections (less than fourteen (14) inches).

3. Abrading and re-welding may also be used to repair seam sections less than fourteen (14) inches in length. Capping shall repair seams longer than 14-inches.
  4. A maximum of two (2) welding bead widths may be allowed to cover an area of excessive grinding or surface blemish. Beads shall not be placed adjacent to each other until the first bead has sufficiently cooled to avoid overheating of the geomembrane. If two (2) welding beads widths do not cover the defect area, a liner cap shall be placed over the defect area as described by these specifications.
  5. Capping: capping may be used to repair large lengths of failed seams. Caps shall be round at the ends, made of the same HDPE liner as the liner to be repaired, and extend a minimum of six (6) inches beyond the centerline of the failed seam. All caps shall have their top edge beveled with an angle grinder prior to placement of the cap, and shall be continuously welded and non-destructively tested using approved methods. Caps, which fail the non-destructive test, shall be repaired and retested until acceptable test results are obtained at the expense of the Installer.
  6. Fishmouths or wrinkles: "Fishmouths" or wrinkles shall be cut along the ridge of the fold to achieve a flap overlap and shall be seamed. All "fishmouths" and wrinkle repairs shall then be capped and non-destructively tested in accordance with these specifications.
  7. Removal of defective seam and replacing with new material.
- D. All repairs shall be non-destructively tested in accordance with these specifications. Repairs, which fail to meet the requirements of this section, shall be repaired and retested until acceptable results are obtained at the expense of the Installer.
- E. In addition the following procedures shall be observed.
1. Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than fifteen (15) minutes prior to the repair.
  2. All geomembrane surfaces shall be clean and dry at the time of repair.
  3. The repair procedures, materials, and techniques shall be approved in advance by the Engineer.
  4. Patches shall extend a minimum of six (6) inches beyond the defect, and all corners shall be rounded to a radius of at least three (3) inches.
- F. Repair Verification
1. Installer shall not cover the geomembrane at locations, which have been repaired until test results with acceptable passing values are available and approved by the Engineer.

### **3.9 GEOMEMBRANE ACCEPTANCE**

- A. Installer retains all ownership and responsibility for the geomembrane until final acceptance by the Owner.
- B. Owner will accept geomembrane installation when:
1. All required documentation from the Manufacturer, Fabricator and Installer has been received and approved.
  2. The installation is completed.
  3. All liner installation documentation has been completed.
  4. All required repairs have been made and verification of the adequacy of all field seams and repairs, including associated testing is complete.

5. Warranties are received.

\*\*\* END OF SECTION \*\*\*

## SECTION 02811

### LANDSCAPE IRRIGATION SYSTEM

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The CONTRACTOR shall construct a multi-row automatic irrigation system, complete and operable, all in accordance with the requirements of the Contract Documents.
- B. Said irrigation system shall include but not be limited to all pipes, fittings, sprinklers, valves, automatic control valves, controllers, valve boxes, drain valves, hose bibb valves, operating wrenches, riser assemblies, direct burial wires, electrical connections, wiring and other appurtenances, piping, connections, testing, cleaning-up, maintenance and adjustments necessary for a complete operating system, ready for immediate use upon completion. Minor items necessary for proper construction and functional operation of this system, not specifically described in the Contract Documents, shall be included as a part of the work of this Section.
- C. All systems shall be designed and construction to meet current City of West Jordan water conservation measures outlined in the Municipal Code 16-10-060.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Landscaping and planting to which the irrigation system is appurtenant shall be constructed in accordance with the requirements of Section entitled, "Landscaping." The Contractor shall coordinate the work of constructing the irrigation system with the planting requirements.
- B. Electrical service shall conform to the requirements of Section entitled, "Electrical General Provisions." Connection to the controller shall be performed as a part of the work of this Section.
- C. Rough grading, final grading, excavation and backfill, and all trenching and trench backfill appurtenant to the installation of the landscape irrigation system shall be performed in accordance with the requirements of Section entitled "Earthwork."
- D. Concrete work as required herein shall be performed in accordance with the requirements of Section entitled, "Cast-in-Place Concrete" and "Minor Concrete," as applicable.
- E. PVC and galvanized steel pipe and fittings shall conform to the requirements of Section entitled "Piping Specialties."

##### **1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

- B. All work hereunder shall be in full accordance with the latest rules and regulations of the governing authorities, state "OSHA," the Uniform Plumbing Code published by the Western Plumbing Officials Association, and other applicable local codes and regulations. Nothing on the Drawings or in the Specifications shall be construed to permit work not conforming to these codes, rules, and orders.

#### **1.04 CONTRACTOR SUBMITTALS**

- A. Manufacturer's literature, samples (where requested by the ENGINEER), and installation instructions shall be submitted in accordance with Section entitled "Contractor Submittals."
- B. Record drawings, showing locations of all valves, pipes (lines) heads, dimensions, controllers, control lines, and electrical wires shall be submitted prior to final inspection.
- C. Controller literature, specifications, installation wiring diagram, and circuit breaker information shall be submitted to the ENGINEER for review prior to ordering.

#### **1.05 QUALITY ASSURANCE**

- A. In addition to other inspection, as provided by the ENGINEER, the CONTRACTOR shall give at least 72 hours notice to the ENGINEER for scheduling the following special inspections:
  - 1. Layout of the system
  - 2. Inspection of trenches, backfilling, and equipment
  - 3. Pressure tests
- B. The CONTRACTOR shall notify the ENGINEER at least 72 hours prior to performing the tests. All tests shall be performed in the presence of the ENGINEER. Test requirements shall be as follows:
  - 1. After assembly and installation, all water pipes, fittings, automatic equipment, and appurtenances shall be tested at a hydrostatic pressure of 150 psi at the lowest point of the system for not less than 60 minutes.
  - 2. The first test shall be made in such a manner that all valves in the new water pipe sprinkler lines will be tested for watertight closure. Valves may be tested in groups or singly while subjected to 150 psi water pressure for a period of not less than 60 minutes.
  - 3. The second test shall be made by forcing all air from the pipes with water and capping or plugging pipe risers. After the pipe risers have been plugged or capped, all line valves shall be fully opened and the pipe lines subjected the full static water pressure for a period of not less than 120 minutes. (Pressure pipelines 150 psi.)
  - 4. The third test requires that lateral lines be tested at 100 psi for 120 minutes.
    - 5. The fourth test requires that all pressure lines be tested at 120 psi for 24 hours.
  - 6. Water lines and valves which show evidence of leakage or fail to be watertight shall be repaired or replaced. After all repairs or replacements have been made, the above-required tests shall be performed again.

#### **1.06 EXISTING UTILITIES AND CONDITIONS**

- A. Prior to cutting into the soil, the CONTRACTOR shall locate all cables, conduits, sewers, septic tanks, and other such underground utilities, and shall take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the CONTRACTOR shall promptly notify the ENGINEER.

- B. The CONTRACTOR shall be responsible for coordinating its work with the operation of existing utilities and new utilities on the Project. The CONTRACTOR shall notify the ENGINEER or its representative when utilities which are in operation require shut-off.
- C. Due to the scale of Drawings, it is not possible to indicate all offset, fittings, etc., which may be required. The CONTRACTOR shall carefully investigate the structural and finished conditions affecting all its work, and plan its work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. The Contract Documents are generally diagrammatic and indicative of the work to be installed. The work shall be installed in the most direct and workmanlike manner, so that conflicts between sprinkler systems, planting, structures, piping, and etc. will be avoided.

#### **1.07 STORAGE OF MATERIALS**

- A. The CONTRACTOR shall be responsible for storage of materials and for damage to the WORK covered by these Contract Documents before final acceptance of its work. The CONTRACTOR shall securely cover openings into the system, and shall cover all apparatus, equipment and appliances both before and after being set in place to prevent obstruction in the pipes and the breakage, misuse, or disfigurement of said apparatus, equipment, or appliances.

#### **1.08 SCHEDULING AND COORDINATION**

- A. The CONTRACTOR shall be responsible for making arrangements for the coordination of its construction operations with those of all others on the job. The CONTRACTOR shall permit others engaged in work to accomplish their portion of the WORK without undue interference or delay.
- B. The CONTRACTOR shall be responsible for the scheduling and coordination of the electrical and water connections and the installation of the piping and equipment in a manner that will effect the earliest completion of the WORK in conformance with the construction progress schedules of all traces and of the Contract Documents.

#### **1.09 GUARANTEE/WARRANTY OF THE IRRIGATION SYSTEM**

- A. The CONTRACTOR shall guarantee the complete irrigation system to be free from leaks or breakage due to defective material or workmanship for a period of one year from the date of acceptance of the complete work by the OWNER. Damage due to sabotage and/or vandalism are specifically excepted from this guarantee.
- B. Other items of the required guarantee shall be as specified in the Section entitled "Landscaping."
- C. The CONTRACTOR shall repair any settling of backfilling trenches occurring during a one-year period after final acceptance without expense to the OWNER including complete restoration of all damaged planting, paving, or other improvements of any kind.
- D. When defective material or workmanship is discovered which will require repair or replacement, all such repair work or replacement work shall be done by the CONTRACTOR at its own expense within 24 hours after written notification is given to the CONTRACTOR by the OWNER of such required repairs. However, if the CONTRACTOR fails to comply with the requirements of the

above guarantee within the 24 hours after notification is given, the OWNER shall proceed to have the repairs made by others at the CONTRACTOR's expense.

## **PART 2 -- PRODUCTS**

### **2.01 GENERAL**

- A. Brand names specified for materials are supplied for the purpose of describing the type, size, quality, and performance of materials. The CONTRACTOR may propose, as substitutions, other manufacturer's materials of equal quality and performance to the ENGINEER for review in accordance with Section entitled "Contractor Submittals."
- B. The CONTRACTOR shall furnish, at no additional charge, all samples necessary for testing as outlined in the Specifications or, when requested, certified evidence of off-site testing.

### **2.02 PLASTIC PIPE AND FITTINGS**

- A. Pipe shall be continuously and permanently marked with the following information: Manufacturer's name, nominal pipe size, PVC type, pressure rating, and extrusion date. Pipe shall conform to the ASTM Specification D-1784-60T.
- B. All plastic pipe for lateral lines shall be PVC (polyvinyl chloride) SDR 21, Class 200, NSF approved.
- C. All materials for pressure main lines shall be PVC (polyvinyl chloride) SDR 21, Schedule 40, NSF approved.
- D. All fittings shall be PVC (polyvinyl chloride) Schedule 40, Type II, NSF, or Schedule 80 as called for in the Contract Documents.
- E. Swing joint ells shall be Schedule 80 PVC.
- F. Pipe shall be 'snaked' in the trench to allow for expansion and contraction.
- G. All changes in direction of pipe shall be made with fittings, not by bending. Appropriate thrust blocks shall be installed per manufacturer's recommendations.

### **2.03 STEEL PIPE AND FITTINGS**

- A. Steel pipe and fittings shall be American Standard Association's schedule 40 galvanized. Street elbows, bushings, and close nipples shall not be allowed.

### **2.04 COPPER TUBING AND FITTINGS**

- A. Copper tubing and fittings shall be seamless annealed conforming to ASTM specifications B-88-58, Type K. Fittings shall be standard wrought copper fittings.

## 2.05 VALVES

- A. General: Hose bibb valves shall be of bronze construction, size 3/4-inch, angle pattern suitable for 250-psi working pressure as manufactured by Crane, American Standard, Kennedy, or equal, with permanent metal sign at noticeable locations. Signs shall be 5-inch x 3-inch in size and read as shown on the Drawings. The signs shall be permanently fastened to pipe, post, or wall at hose bibb.
- B. Main shut-off valves shall be bronze gate valve with positive seal conforming to AWWA Specifications, Class 150 or better.
- C. Isolation valves for main lines shall be bronze gate valves with wedge disc, Class 125, screwed ends and operating nut as manufactured by Rainbird, Buckner, or equal.

## 2.06 CONTROL WIRING

- A. Control wiring shall be Standard UF Direct Burial Copper Wire, Type UF Bearing, U/L approved for direct underground burial in National Electrical Code Class II circuits, AWG sizes.
- B. Conductor of electrical conductivity shall be grade copper meeting requirement of ASTM B 3-74 (1980).
- C. All splices shall be made with wire connectors, such as Rainbird Pen Tit, Scotch Lock, or equal. Contractor may splice in pull boxes but underground splices will not be allowed.
- D. Control wiring shall be installed underground in the mainline trench taped to the mainline at twenty foot intervals. Install wires under the main line. Where wires are separated from mainline, install in conduit. Provide a minimum loop of 18 inches at each valve, change or direction, every 500 feet, and at each controller.
- E. "Pulling-In" of wire for installation without trenching will not be allowed unless the wire is being pulled through conduit. All wire shall be laid in trenches and shall be carefully back-filled to avoid any damage to the wire insulation or wire conductors themselves. In rocky areas, the trench shall have a 6 inch layer of clean sand on the bottom of the trench before the wire is laid into the trench and back-filled. The wire shall have a minimum cover of 18 inches. Where wire passes under roadways, walls or any other paved areas, it shall be installed in PVC schedule 80 pipe sleeve of proper size required for the number of wires being placed in it. Maxi satellite control wire is permitted to be laid in the same trench with conduit. but must be physically separated from the conduit as much as possible by laying each in opposite sides of the trench.
- F. For cable/conduit systems, pull boxes are required to be placed at a maximum spacing of 250 feet.

## 2.07 PRESSURE VACUUM BREAKERS

- A. Pressure vacuum breakers shall be "FEBCO" Model 775, or approved equal. Pressure vacuum breaker assemblies shall consist of an approved body, check valve, vacuum relief, inlet and discharge shutoffs, and field test cocks. Vacuum relief shall have atmospheric opening of greater diameter than

IPS of unit. Vacuum relief shall be separate and independent from check valve member. All nipples or other fittings shall be red brass. The unit shall have a protective screen or strainer before the unit to eliminate insects or debris from entering. The breaker shall have approval of the State Division of Drinking Water. Flow loss at 100 gpm shall not exceed 4 psi. A 3/4-inch galvanized steel pipe in sleeve for irrigation blowout shall be provided as shown.

## **2.08 PVC SOLVENT CEMENT AND PRIMERS**

- A. Solvent Cement shall be NSF approved and shall meet requirements of ASTM D 2564-80.
- B. Primer shall be NSF approved and shall be Weld-On, P-70 Industrial Polychemical Service, or equal.

## **2.09 WORM GEAR CLAMPS**

- A. Worm-gear clamps shall be stainless steel.

## **2.10 VALVE AND CONTROLLER BOXES**

- A. Boxes for valves and controllers shall be heavy duty fiberglass, PVC, or concrete and shall be complete with identification lid. Boxes shall be sized for equipment within box, depth of installation, and operation and maintenance space required.

## **2.11 SATELLITE CONTROLLERS**

- A. The Contractor is to supply and install the necessary satellite controller as indicated in the Contract Documents listed under 'Irrigation Legend'. These controllers shall be state of the art, solid state electronic controllers as manufactured by Rainbird, Toro, or an approved equal.
- B. The electrical power source shall be provided by the City. The Contractor shall then be responsible for making the electrical connection to the controller.

## **2.12 OTHER MATERIALS**

- A. Other materials required or necessary shall be as indicated on drawings and/or as required for best quality work.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. Installation of the irrigation system shall be performed after the finish grading but prior to landscaping.
- B. All valves, fittings, heads, and piping shall be installed as shown and all connections made to permit the irrigation system to function properly through its entire length.
- C. All materials and equipment shall be installed in strict accordance with manufacturer's written instructions and recommendations and all local and state codes, laws, ordinances, and regulations.

- D. Before proceeding with the installation of any section or unit of the irrigation system, the CONTRACTOR shall check and verify the correlation between ground measurements and drawings and shall advise the ENGINEER of any discrepancies.

### **3.02 EXCAVATION**

- A. Trenches shall be dug as wide and as deep as necessary to properly install the irrigation lines.
- B. Pipe trenches shall be straight, or "snaked" slightly allowing for expansion and contraction of PVC pipe.
- C. Subsoil shall be kept separate from topsoil, where possible.
- D. Minimum cover depth shall be as follows:
  - 1. Supply pressure lines from water source to control valves: 24-inches unless otherwise indicated or noted.
  - 2. Lateral lines from control valves to sprinkler heads shall be 18-inches unless otherwise indicated or noted. Lateral lines under paving, roadways, and driveways shall have 24-inches of cover and be located in Schedule 40 PVC sleeves.
  - 3. Trenches for control wire only shall be 18 inches deep unless otherwise indicated or noted. Control wires under concrete walks and slabs, paving, roadways, and driveways shall be installed in Schedule 40 PVC sleeves.
- E. A trench of sufficient width shall be provided to allow for proper tamping around pipe.
- F. Rocks and other debris shall be removed or cut out to the width of the trench and to a depth of 6 inches below the trench bottom.
- G. Avoid cutting roots of existing trees. Notify the Landscape Architect if roots larger than 1-inch are encountered.

### **3.03 PIPING - GENERAL**

- A. Piping shall be laid out and installed in accordance with manufacturer's printed recommendations and industry standards. Substantial support shall be provided at all points, and pipes shall be snaked slightly allowing for expansion and contraction.
- B. Minimum 1-inch vertical clearance shall be between lines crossing at angles greater than 45 degrees.
- C. Minimum 3-inches horizontal and vertical clearances shall be between all other lines.
- D. Teflon thread sealant 3/4-inch wide (tape or liquid), Rectorseal No. 5, or equal, shall be used at all threaded joints.
- E. Galvanized steel pipes shall have clean standard threads of standard lengths. Joints shall be made up with pipe compound applied to male threads only and not more than 2 threads shall show at the joints when connected.

F. Pipe sleeves shall be provided under all paving and where necessary for passage under finish surface material, future replacement, and for protection of PVC piping and control wire.

**3.04 PLASTIC PIPE**

A. The pipe shall be guaranteed by the manufacturer to be suitable to operation under the conditions of this installation and shall be guaranteed free from defects in workmanship and quality.

B. The pipe shall be connected by O-ring type or by solvent-weld joints as outlined below. Joints shall be made in strict accordance with the manufacturer's printed recommendation.

C. The plastic pipe sections shall be placed accurately to line and grade in the prepared trenches. The inside of all pipe shall be clean and free from foreign matter and shall be end-reamed to remove burrs and provide full inside diameter of the pipe end.

D. Pipe assembly shall have a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. All adjustments to grade shall be made by scraping away or filling in with clean earth backfill material, well compacted under the body of the pipe. Wedging of pipe will not be permitted. The inside of all pipe shall be clean and free from foreign materials before joints are assembled.

E. Sealant tape shall be used on all threaded joints.

F. All pipeline open ends upon which the WORK has been stopped shall be closed at the end of each day's construction work with a suitable temporary plug to prevent entrance of any foreign materials into the assembled pipeline.

G. Pressure pipe shall be defined as all piping for this system.

H. O-ring type flexible coupling pipe shall be used on pressure pipes 4-inch or larger.

I. Pressure pipe fittings on the 4-inch main lines going to automatic control valves shall be O-ring type with 2-inch threaded outlet.

J. Three-inch main lines and fittings of pressure piping shall be solvent weld type.

K. Pressure piping shall be provided with portland cement concrete thrust blocks. Thrust blocks shall be constructed at the following places:

1. Where pipe changes direction at fittings.
2. Where pipe changes size.
3. Where line terminates.
4. Around gate valves (bottom half of valve in concrete bolts exposed for change of top half).

L. Thrust blocks shall be constructed of 2000-psi concrete, as follows:

| THRUST BLOCKS                        |            |           |           |        |
|--------------------------------------|------------|-----------|-----------|--------|
| Minimum Square Feet of Affected Area |            |           |           |        |
| PIPE SIZE                            | DEAD ENDS, | 90 DEGREE | 45 DEGREE | 22-1/2 |

|        | TEES OF VALVES | BENDS      | BENDS      | DEGREE OR LESS BENDS |
|--------|----------------|------------|------------|----------------------|
| 3-inch | 3.0 sq.ft.     | 4.0 sq.ft. | 3.0 sq.ft. | 3.0 sq.ft.           |
| 4-inch | 3.0 sq.ft.     | 4.0 sq.ft. | 3.0 sq.ft. | 3.0 sq.ft.           |

M. The areas given in the above table shall be measured in a place perpendicular to the longitudinal axis of the pipe or to the longitudinal axis of the thrust developed.

### 3.05 VALVES

- A. Piping systems shall be supplied with valves at all points as shown or specified herein so arranged to give complete regulating control throughout. Automatic control valves and gate valves shall be as detailed in the Contract Documents or as otherwise directed by the ENGINEER.
- B. Valves shall be the full size of the line in which they are installed unless otherwise indicated.
- C. Hose bibbs shall be installed as shown.
- D. Gate valves shall be line (pipeline) size, shall be installed where indicated on the Drawings, and shall be properly blocked to a cast-iron water works valve box. All gate valves shall be provided with 2-inch square operating nuts. One 5-foot wrench for each 3 gate valves shall be furnished.
- E. Quick-coupling valves shall be provided, located, and installed as shown in the Contract Documents. Quick-coupling valves shall be installed with one-inch swing joint. All quick-coupler lines shall be installed not less than 18 inches below grade.
- F. A main stop and drain valve shall be installed near the point of connection to the main line.
- G. Drain valves shall be installed at low points along the main. It shall be the CONTRACTOR's responsibility to see that the main drains properly.
- H. Gravel sumps 2-feet by 2-feet by 2-feet in size and filled with 3/4-inch to 1-inch size round gravel shall be provided at each manual drain valve and at low sprinkler head locations for drainage, (spray heads only).
- I. Double-check valve shall be installed as shown, with a boiler drain for winter blowout.

### 3.06 PRESSURE TYPE VACUUM BREAKER

- A. Installation of pressure-type vacuum breaker shall be at location shown and in accordance with manufacturer's printed recommendation and as detailed.

### 3.07 VALVE BOXES

- A. Valve boxes shall be set 1/2-inch above the designated finish grade in lawn areas and 2-inches above finish grade in ground cover areas.

- B. Valve boxes located near walks, curbs, and paving shall be installed in such a way as to allow for valve boxes to abut those items with top surface matching plane as items listed above.

### **3.08 WIRING AND ELECTRICAL WORK**

- A. All electrical equipment and wiring shall comply with local and state codes and shall be installed by those skilled and licensed in the trade. Unless the governing codes specify otherwise, low voltage control wire may be installed by the CONTRACTOR when code allows. All 115- and 24-volt lines shall be installed. CONTRACTOR shall make necessary "Hot" connections.
- B. All 115-volt wire shall be installed in conduit and taken from appropriate sources as shown in the Contract Documents. CONTRACTOR shall coordinate supplier and installer.
- C. The CONTRACTOR shall provide low voltage, 24-volt direct burial wires. Wire size shall be as shown in the Contract Documents, but shall be not less than No. 14. Where sizes are not shown, they shall be sized per wire manufacturer's sizing charts and specifications.
- D. The CONTRACTOR shall provide all wiring, conduits, sleeves, and connection for the low voltage electrical system between controller and valves, and where else shown and necessary for a complete and operable irrigation system.
- E. Wires shall be color-coded as follows:
  - 1. Control wires shall be red.
  - 2. Ground (neutral) wire shall be white.
- F. All splices shall be moisture proof using specified electrical connectors.
- G. Wires shall be bundled together and wrapped with electrical tape similar to PVC at 5-foot intervals. They shall be buried in same trench as the pipe where possible.
- H. An expansion curl should be provided within 3-feet of each wire connection and at least every 100-feet of wire length on runs more than 100-feet in length. Expansion curls shall be formed by wrapping at least 5 turns of wire around a 1-inch pipe or more in diameter, then withdrawing pipe.
- I. All conduits and sleeves necessary for running wires under concrete, walks, and paving shall be furnished and installed before said concrete, walks, and paving work is constructed.
- J. Wire shall be continuous without splices and shall be routed in main line trench whenever possible.
- K. All wire under paving shall be encased in PVC pipe; changes in direction under paving shall be made with sweep ells.

### **3.09 PIPE TRENCH BACKFILL**

- A. After pipe and wires have been installed, the trenches shall be backfilled. The backfill operation must provide a firm continuous support for the pipe.
- B. Backfill material shall be free of rocks and other materials that may damage the piping.

- C. Bottom of trenches shall be smooth and free of sharp rocks and other objects that may damage pipe.
- D. The initial backfill shall be accomplished by carefully tamping selected material (from material excavated from the trench) under the pipe and between the pipe and the trench walls.
- E. The pipes shall be filled with water and pressurized during backfilling operations if necessary, to prevent drainage to piping.
- F. The backfill shall be carefully installed around and over the pipe to approximately 10-inches of the ground surface, then water shall be allowed to flow in the trench. After this puddling operation has been completed and allowed to stand for 24 hours, the balance of the materials shall be placed in the trench to the sub-grade line (leaving room for topsoil). Rocks and other materials found in the backfill shall be removed. The backfill shall be compacted carefully and thoroughly.
- G. Couplings and fittings shall be left exposed until leakage tests have been completed, unless the ENGINEER orders otherwise.
- H. Topsoil shall be installed prior to planting.

### **3.10 TESTING AND ADJUSTMENTS**

- A. The ENGINEER shall be notified by the CONTRACTOR prior to performing hydrostatic tests on the irrigation system in place. This test shall be done by the CONTRACTOR in the presence of the ENGINEER. With the risers capped, pressurize the system to two times the normal maximum site pressure. Pressure shall be maintained for 24 hour minimum. If leaks develop, repair and re-test until the irrigation system provides water tight. The test results will be acceptable to the ENGINEER when no leakage or loss of pressure is evident during the test period. Defects shall be detected and repaired prior to retesting.
- B. No debris, waste material, or rubbish shall be permitted to accrue on the site. Debris shall be removed on a daily basis and the entire work area returned to playable condition. As construction progresses and when work is completed in one area, debris, waste material, or rubbish shall be completely removed before the CONTRACTOR moves to another area.
- C. A coverage test shall be conducted to check all areas for complete coverage and adequate precipitation.
- D. The operation of all controllers and valves shall be demonstrated to the satisfaction of the Landscape Architect.

### **3.11 MAINTENANCE**

- A. Water shall be applied as necessary to germinate seeds and prevent plant wilt. Automatic irrigation systems shall be operated by the Contractor per manufacturer's specifications and sprinkling program approved by the Landscape Architect.
- B. The Contractor shall continuously maintain all areas included in the contract during the progress of

the project until final acceptance of all work by the Landscape Architect and the City. The Contractor shall replace any plant material which dies or is damaged under his care within 48 hours.

- C. The Contractor shall protect his work from damage during the course of this project. Immediate repairs shall be made to areas damaged by vehicular, equestrian, or pedestrian traffic to restore the specified grades and plantings.
- D. Contractor shall exterminate pests or insects as necessary and repair or replace damaged areas and plantings.

\*\*\* END OF SECTION \*\*\*

## SECTION 02902

### REVEGETATION PLAN

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. All disturbed areas shall be graded as indicated in the Contract Documents, have topsoil respread thereon, and revegetated except road pavement and shoulders, riprap and cut slopes defined in this specification. Four habitat types, defined from moisture regimes (upland, dikes, fluctuating water table, and permanently wet) have the potential to be impacted during the construction of the project. This revegetation plan provides guidelines to reestablish the native vegetation in these different zones. This section includes soil preparation, weed control, erosion control, planting, watering, and plant establishment and maintenance.

##### **1.02 SUBMITTALS**

- A. Submit shop drawings and other items in accordance with the Contract Documents.

##### **1.03 GUARANTEE**

- A. In June or July of the summer following the fall plantings, the Construction Manager will determine if a satisfactory stand has been established. If not, the Construction Manager will notify the Contractor and reseeding efforts will be scrutinized and again implemented that fall, with associated monitoring the following summer.

##### **1.04 OBSERVATIONS**

- A. Request observation by the Construction Manager at least 48 hour in advance of the time observation is required.
- B. Observation will be required for the following parts of the work:
1. After completion of grading and soil preparation, and prior to reseeding and plant.
  2. Plant material when delivered to the project site.
  3. When planting and all other indicated or specified work has been completed.
  4. Upon completion of maintenance and plant establishment.

#### **PART 2 -- PRODUCTS**

##### **2.01 TEMPORARY SEEDING**

- A. Temporary seeding shall be used for disturbed areas where they will not be stabilized for long periods of time (over 45 days). Temporary seeding means the growing of a short term cover (plants) on a disturbed construction site that may be in danger of erosion from wind or water. The purpose of temporary seeding is to reduce erosion and sedimentation loss by stabilizing disturbed areas.

## 2.02 PERMANENT SEEDING

- A. General: The purpose of this practice is to establish perennial and permanent plant material for a site where development is complete or will have no further disturbance. This practice is to be used for areas that have been brought to final grade and will be to receive vegetative cover as a permanent method to control erosion from wind or water.
- B. Installation: The Contractor is to comply with the following directions in installing permanent seeding materials:
1. Install berms or swells to prevent concentrated flows from adjacent properties
  2. The prepared seedbed should be granular, loose, uniform grades to 2-4 inches in depth.
  3. Surface roughening - If rainfall causes the soil surface to become sealed or crusted, loosen it just prior to seeding by discing, harrowing, raking or other approved methods.
  4. Apply fertilizer as required to existing soil. If hydro-seeding methods are used, the fertilizer should be applied a minimum of 3 days after seed and mulch have been applied.
  5. Mulch - The seed supplier shall prepare written recommendations on how to ensure proper germination of seeds, which are to be followed by the Contractor.
- C. Seed Mix: The following seeds shall be included in the proposed seed mix.
1. Sodar Streambank Wheatgrass
  2. Agropyron, riparium

This is a native sod grass of the Northern Great Plains plant growth region and the western intermountain area. It tolerates drought and spreads rapidly to form a good ground cover. It appears early and resembles thick spike wheatgrass. It is used widely as a low-growing, low maintenance cover. This is useful for roadside seeding, recreation areas, disturbed areas, and other sites where a low maintenance turf is desired.

3. Nezipar, Indian Ricegrass
4. Oryzopsis hymenoides

This grass is dense tufted perennial with upright stems. It is widely distributed over the west where it is one of the most drought-enduring native range grasses. It grows on semideserts, sand dunes, sandy plains, canyons, hillsides, foothills, exposed ridges, and dry, sandy, rocky, or granulated shale sites. It is one of the first species to become established on disturbed sandy sites. This species has excellent seedling vigor and is easily established. Birds, especially, mourning dove and pheasant and small rodents relish the plump nutritious seeds.

5. Vaughn, Sideoats Grama
6. Bouteloua Curtipendula

The primary use of sideoats Grama is in the Central and Northern Great Plains, but it grows in the Rocky Mountain area. This tolerates drought and has excellent seedling vigor. It is also a major warm-season, slightly spreading bunch grass.

7. Blue bunch Wheatgrass
8. Agropyron Spicatum

This is an important bunch grass of the intermountain region. However, the seed is generally available in limited quantities.

### 2.03 SEED MIXTURES

- A. The seeding mixture for each of these habitat types has been identified in the following tables. All seeding mixes and application rates have been derived from the Interagency Forage and Conservation Planting Guide for Utah (EC433). Seed mixes will be purchased through the USFS or an authorized supplier. All seeds will be furnished in standard containers labeled with seed names, lot numbers, percent species in the mix, net weight, percent purity, germination, and hard seed and maximum weed seed content.

| UPLANDS                |                       |                        |                      |                           |
|------------------------|-----------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name | Species<br>Latin Name | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses:               |                       |                        |                      |                           |
| Intermediate wheat     | Elymus hispidus       | 15                     | 3                    | 1.10                      |
| Thickspike wheat       | Elymus lanceolatus    | 10                     | 2                    | 0.73                      |
| Great Basin wildrye    | Elymus cinereus       | 10                     | 2                    | 0.72                      |
| Letterman needle       | Stipa letermanii      | 7                      | 1.4                  | 0.51                      |
| Western wheat          | Elymus smithii        | 7                      | 1.4                  | 0.51                      |
| Slender wheat          | Elymus trachycaulus   | 7                      | 1.4                  | 0.51                      |
| Big blue               | Poa ampla             | 5                      | 1                    | 0.37                      |
| Mountain brome         | Bromus carinatus      | 5                      | 1                    | 0.37                      |
| Forbs:                 |                       |                        |                      |                           |
| White sweetclover      | Melilotus alba        | 10                     | 2                    | 0.73                      |
| Chickpea milkvetch     | Astragalus cicer      | 10                     | 2                    | 0.73                      |
| Small burnet           | Sanguisorba minor     | 5                      | 1                    | 0.37                      |
| Palmer's penstemon     | Penstemon palmeri     | 2                      | 0.4                  | 0.15                      |
| Lewis flax             | Linum perenne/lewisii | 2                      | .4                   | 0.15                      |
| Shrubs:                |                       |                        |                      |                           |
| White Snowberry        | Symphoricarpos albus  | 3                      | 0.6                  | 0.22                      |
| Bitterbrush            | Purshia tridentate    | 2                      | 0.6                  | 0.15                      |
| Total:                 |                       | 100                    | 20                   | 7.35                      |

| DIKES                   |                       |                        |                      |                           |
|-------------------------|-----------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name  | Species<br>Latin Name | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses and Grasslikes: |                       |                        |                      |                           |
| Streambank wheat        | Agropyron riparium    | 36.6                   | 3                    | 1.10                      |
| Blue wildrye            | Elymus glaucus        | 24.4                   | 2                    | 0.73                      |
| Western wheat           | Agropyron smithii     | 24.4                   | 2                    | 0.73                      |
| Forbs:                  |                       |                        |                      |                           |
| Western yarrow          | Achillea millefolium  | 1.2                    | 0.1                  | 0.04                      |
| Northern sweetvetch     | Hedysarum boreale     | 12.2                   | 1                    | 0.37                      |
| Pacific aster           | Aster chilensis       | 1.2                    | 0.1                  | 0.04                      |
| Total:                  |                       | 100                    | 8.2                  | 2.98                      |

| FLUCTUATING WATER TABLE |                        |                        |                      |                           |
|-------------------------|------------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name  | Species<br>Latin Name  | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses and Grasslikes: |                        |                        |                      |                           |
| Tufted hair             | Deschampsia caespitosa | 41.7                   | 1                    | 0.37                      |
| Baltic rush             | Juncus balticus        | 4.2                    | 0.1                  | 0.04                      |
| American slough         | Beckmannia syzygachne  | 12.5                   | 0.3                  | 0.11                      |
| Forbs:                  |                        |                        |                      |                           |
| Rocky Mountain Iris     | Iris missouriensis     | 20.8                   | 0.5                  | 0.18                      |
| Golden banner           | Thermopsis montana     | 20.8                   | 0.5                  | 0.18                      |
| Total:                  |                        | 100                    | 2.4                  | 0.88                      |

| PERMANENTLY WET   |                       |                        |                      |                           |
|---|-----------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name  | Species<br>Latin Name | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses and Grasslikes:   |                       |                        |                      |                           |
| Nebraska sedge  | Carex nebrascensis    | 37.5                   | 3                    | 1.10                      |
| Beaked sedge  | Carex rostrata        | 25                     | 2                    | 0.73                      |
| Baltic rush   | Juncus arcticus       | 37.5                   | 3                    | 1.10                      |
| Forbs:  |                       |                        |                      |                           |
| Forb species not included<br>since most will return<br>naturally with proper<br>care. |                       |                        |                      |                           |
| Total:  |                       | 100                    | 2.4                  | 0.88                      |

#### 2.04 HERBICIDE

- A. Prior to application of appropriate seed mix, a USDA Forest Service Pesticide-Use Proposal (Reference PSM 2150) will be filed with the Spanish Fork Ranger District for the application of herbicides for the control of noxious weeds.
- B. Herbicide shall be a Banvel 4-W.S. (4 pounds active ingredient per gallon [lbs ai/gal] and 2, 4-D Ester (4 lbs ai/gal) mixture will be used at 1 pint to 2 quarts Banvel/1-2 quarts 2, 4-D per 99 gallons and applied by backpack sprayer.

#### 2.05 WOOD FIBER MULCH

- A. Use wood fiber mulch produced from whole wood chips which have been steamed and defibrated. Wood fiber mulch shall be free of germination or growth inhibiting substances and conform to the following:

|                        |  |
|------------------------|--|
| Moisture content       | 15% maximum of oven dried weight of fibers                                       |
| Organic matter         | 98% minimum of oven dried weight of fibers                                       |
| Ash content            | 1% maximum of oven dried weight of fibers  |
| pH range               | 4.0 to 6.0   |
| Water holding capacity | 10 times oven dried weight of fibers   |
| Fiber length           | 30% minimum at least of 0.16-inches long, 50% minimum retained on 28 mesh screen |

## **2.06 LIQUID TACKIFIER**

- A. Use non-flammable concentrated liquid polymer emulsion with a minimum 60 percent solids. Tackifier should be non-toxic to plants and animals and shall allow water to penetrate soil.
- B. Chemical stabilization can be used as an alternative in areas where temporary seeding practices are applied.
- C. The application rates and procedures recommended by the manufacturer of a chemical stabilization product shall be followed to prevent the products from forming ponds and from creating large areas where moisture cannot get through.

## **2.07 HYDROSEEDING**

- A. The hydroseed mix should be in a slurry having 60 pounds per acre (lb/acre) of tackifier and 400 lb/acre of wood fiber mulch. The tackifier will be derived from natural organic plant sources containing no growth- or germination-inhibiting materials, capable of hydrating in water.
- B. Wood fiber mulch will be processed wood fiber containing no growth- or germination-inhibiting materials, dyed a suitable color to ascertain material placement, and when hydraulically applied to the ground, will allow absorption and percolation of moisture.

## **2.08 PLANT MATERIAL**

- A. Willow plugs are available at the Contractor's expense through the USFS Spanish Fork Ranger District's contracted supplier (Lone Peak Nursery) for native vegetation.

## **2.09 EROSION CONTROL (EXCELSIOR BLANKET)**

- A. The excelsior blanket shall consist of a machine-produced mat of curled wood excelsior of 80 percent, 6-inch or longer fiber evenly distributed over the entire area of the blanket. Fiber dimensions shall be 0.21-inch by 0.42-inches. Average weight per square yard to be 0.08 pound at the time of manufacture.
- B. The top side of each blanket shall be covered with a biodegradable extruded plastic mesh. The blanket shall be made smolder-resistant without the use of chemical additives.
- C. The staples shall be made of wire, 0.091-inch in diameter or greater, "U" shaped with legs 6-inches in length and a 1-inch crown. Size and gauge of staples used may vary with soil conditions and shall be reviewed by the Owner's Representative.
- D. Excelsior blanket shall be by American Excelsior Company, 350 N. Redwood Road, North Salt Lake City, Utah, (801) 292-6060, or approved equal.

## **2.10 INLET SEDIMENT BARRIERS**

- A. The Contractor shall install inlet sediment barriers as indicated on the Contract Documents. An inlet sediment barrier is a temporary barrier placed around a storm water catch basin.

- B. One of two types of inlet sediment may be required by the City. These two types are differentiated based on the surface around the catch basin; which can either be unimproved (dirt, etc.) or an improved area. In an unimproved area the inlet barrier is made of geotextile style silt fence. In an improved area such as paved areas, the inlet barrier is made of block and wire enclosed gravel. Bales of straw will not be allowed in either case.

## **2.11 MULCH**

- A. Mulch is a temporary soil stabilization or erosion control practice where materials such as grass, hay woodchips, wood fibers, straw, or gravel are placed on the soil surface. The addition to stabilizing soils, mulching can reduce the speed of the storm water runoff over an area. The use of mulch can increase the result of seeding and seedling survival rates. Use of mulch may require a binder or netting to anchor the mulch to the ground.

| TABLE 1<br>MULCH APPLICATION RATES |                                |                         |                                 |
|------------------------------------|--------------------------------|-------------------------|---------------------------------|
| TYPE OF MULCH                      | MULCH RATE<br>(Tons per Acre)  | LAND SLOPE<br>(Percent) | SLOPE LENGTH<br>LIMIT<br>(Feet) |
| Straw                              | 1.0                            | 1-5                     | 200                             |
|                                    | 1.0                            | 6-10                    | 100                             |
|                                    | 1.5                            | 1-5                     | 300                             |
|                                    | 1.5                            | 6-10                    | 150                             |
|                                    | 2.0                            | 1-5                     | 400                             |
|                                    | 2.0                            | 6-10                    | 200                             |
|                                    | 2.0                            | 11-15                   | 150                             |
|                                    | 2.0                            | 16-20                   | 100                             |
|                                    | 2.0                            | 21-25                   | 75                              |
|                                    | 2.0                            | 26-33                   | 50                              |
|                                    | 2.0                            | 34-50                   | 35                              |
|                                    | Crushed Stone<br>¼ to 1 ½-inch | 135                     | <16                             |
| 135                                |                                | 16-20                   | 150                             |
| 135                                |                                | 21-33                   | 100                             |
| 135                                |                                | 34-50                   | 75                              |
| 240                                |                                | <21                     | 300                             |
| 240                                |                                | 21-33                   | 200                             |
| 240                                |                                | 34-50                   | 150                             |
| Wood Chips                         | 7                              | <16                     | 75                              |
|                                    | 7                              | 16-20                   | 50                              |
|                                    | 12                             | <16                     | 150                             |
|                                    | 12                             | 16-20                   | 100                             |
|                                    | 12                             | 21-33                   | 75                              |
|                                    | 25                             | <16                     | 200                             |
|                                    | 25                             | 16-20                   | 150                             |
|                                    | 25                             | 21-33                   | 100                             |
| 25                                 | 34-50                          | 75                      |                                 |

Please Note: Slope Length Limit which is specified is the length of slope the Mulch rate specified is effective.

## 2.12 STRAW MULCH

- A. Material for straw mulching shall consist of the straw from oats, barley, wheat, or rye and shall be seed free or fumigated to prevent introduction of weeds. At least 50-percent of the mulch by weight shall be 10-inches or more in length. Old, dry straw which breaks and does not bend is unacceptable.

- B. Straw mulch is anchored or punched in by using a tracked construction vehicle. Straw mulch is to be applied at a rate of 2 ½-tons per acre. See Standard Drawing No. 5245 for additional information.
- C. Straw Mulch is to be anchored by the use of a photodegradable extruded plastic netting and stakes to anchored mulch to ground

### **2.13 HYDRO MULCH**

- A. The manufacturer of Hydro mulch shall have recommended written application rates for the products. The recommendations shall address the following:
  - 1. Type of soil on slope to be protected.
  - 2. Percentage of slope.
  - 3. Application rate.

## **PART 3 -- EXECUTION**

### **3.01 NOXIOUS WEED CONTROL**

- A. Upland areas are defined as all areas 100-feet or more from rivers or other water sources; not shown as wetlands on the drawings.
- B. The disturbed upland areas will be sprayed primarily for the control of musk and Canada thistle. There will be two seasons of spraying; once in May as the thistle rosettes emerge, and once in July/August after bolt, but before seed set. All spraying activity will be coordinated with the Draper City and Salt Lake/Utah counties. Records will be kept indicating treatment rates, treatment locations, acres treated, etc.
- C. In all other areas of disturbance, two mechanical weed removal treatments will be used to control these noxious weeds; once in May as the thistle rosettes emerge, and once in July/August after bolt, but before seed set.

### **3.02 GROUND PREPARATION**

- A. Perform rough grading on slopes to be reseeded to the lines and grades shown on the contract drawings except grading shall be approximately 6-inches below finished grade to allow for placement and spreading of topsoils. Slope ground to drain in agreement with contract drawings. Prepare ground surface for reseeded by restoring topsoils removed during clearing and grubbing and spreading them evenly over the areas to be hydro seeded to minimum depth of 6-inches.
- B. On all areas to be reseeded, roughen the soil surface immediately prior to reseeded. The intent is to create small ledges, cracks and crevices for the seeds to lodge in and reduce erosion. These created depressions and ledges will also provide shelter for small seedlings and increase water infiltration/retention and root penetration.
- C. On slopes steeper than 3:1, rake soils perpendicular to the slope or run bulldozer tracks up and down the slope to create small horizontal ledges for the seedbed. This final "pass" with the

dozer or rake is of critical importance in creating an adequate seedbed and controlling erosion. Where slopes are flatter than 3:1, use a disk or similar equipment to roughen the topsoil in furrows perpendicular to the slope.

**3.03 AREAS NOT REQUIRING 6-INCHES OF TOPSOIL AND RESEEDING**

- A. All areas disturbed by construction shall receive a 6-inch minimum thickness of topsoil (stockpiled during clearing and grubbing) and shall be reseeded with one of the four specified seed mixtures except in the areas listed below:
  1. On the hard rock cut slopes list in paragraph 3.05.
  2. On road pavement and road shoulders to edge of shoulder.
  3. On minor approach roads to edge of shoulder.
  4. On riprap

**3.04 REPLACEMENT OF HERBACEOUS SPECIES**

- A. All reseeded efforts shall be conducted in November; later if snow conditions permit. On all upland areas, the areas to be reseeded will be prepared by mechanically disturbing the soil immediately before seeding. Additionally, after seeding, the soil shall be mechanically treated in the same fashion. Seeds shall be broadcast at rates as indicated in the tables.
- B. In all other habitat types, the areas will be reseeded without any seedbed preparation. At river crossings and at any areas within 100-feet of free water which may cause erosion, seeds will be hydro seeded. After application of seed hydro mix, another application will be made with slurry containing only tackifier (60 lb/acre) and wood fiber mulch (1,500 lb/acre).

**3.05 INSTALLATION OF EROSION CONTROL (EXCELSIOR) BLANKET**

- A. Areas to Receive Excelsior Blanket. Apply erosion control blanket on all disturbed slopes steeper than 2.5:1 except the hard rock road cut (not fill) slopes listed below by road station:

| Station to Station | Cut Slope | Bedrock Material |
|--------------------|-----------|------------------|
| R20+00 to R22+00   | 0.5:1     | Sandstone        |
| R141+00 to R145+00 | 0.5:1     | Conglomerate     |
| R185+00 to R195+00 | 1:1       | Conglomerate     |
| R207+00 to R214+00 | 1:1       | Limestone        |
| R215+50 to R229+00 | 1:1       | Limestone        |

- B. Excelsior Blanket Installation. Complete all soil preparation and seeding in areas to receive erosion control blanket before placing blanket. Apply erosion control blanket within 5 calendar days after seeding and before precipitation falls. Install blanket per manufacturer's instructions with correct side up. Do not stretch the blanket. Allow it to lie loosely on the soil to achieve maximum soil contact. Horizontal seams within 15-feet of the top of the slope are not permitted. Do not tear or rip the blanket during installation. Staple the blanket per manufacturer's specifications. Staple requirements vary according to steepness and length of

slope. Place additional staples in areas such as swales, against rock outcroppings and as required to provide blanket to ground contact.

- C. Deliver all seed to the project site unmixed and in sealed containers. Label all seed according to state and federal seed laws with each container bearing the seed suppliers tags indicating the container weight, seed type (genus and species), seed purity percent, seed germination percent and date seed was tested. A sample of each seed type shall be collected at the time of delivery to the site by the Construction Manager. Samples will be tested to assure compliance with the seed specifications.
- D. Conduct all reseeding in the months of November or December to take advantage of winter moisture and assure the success of revegetation. Do not apply hydro seed during windy, rainy or snowy conditions or when the ground temperature is below 45-degrees Fahrenheit.

### **3.06 REPLACEMENT OF WOODY VEGETATION (WILLOWS)**

- A. During construction through riparian areas with woody vegetation (especially willows), the vegetation and the soil in which the vegetation is growing will be removed by the backhoe and stockpiled. These clumps of woody vegetation will be incorporated into the revegetation of woody areas. If this is not feasible, new seedlings may be used.
- B. Following the application of erosion control material, either the large aggregates of woody vegetation and soil that were removed previously and temporarily stored in the shallows, or cuttings of Yellow willow (*Salix lutea*) and Coyote willow (*Salix exigua*) supplied by the USFS's contracted supplier, will be placed over the matting. Cuttings will be spaced on 6-foot centers and in all areas where woody vegetation grew prior to construction activities.

### **3.07 SITE PROTECTION**

- A. Construct a 4-foot high fence built of 4-inch by 4-inch square wire and tuber pole mesh along all riparian areas, which have been revegetated. Additionally, a similar fence will be constructed along the pipeline in areas designated by the Construction Manager that may tempt vehicular exploration. Signs explaining the revegetation efforts will be erected.
- B. Remove all protective fencing following establishment of the reseeding effort, at the direction of the Construction Manager.

\*\*\* END OF SECTION \*\*\*

**SECTION 02902A**  
**REVEGATION PLAN**

**PART 1 -- GENERAL**

**1.01 SCOPE**

- A. All disturbed areas shall be graded as shown on the drawings, have topsoil respread thereon, and revegetated except road pavement and shoulders, riprap and cut slopes defined in this specification. Four habitat types, defined from moisture regimes (upland, dikes, fluctuating water table, and permanently wet) have the potential to be impacted during the pipeline construction and the road improvements activities proposed in Diamond Fork. This revegetation plan provides guidelines to reestablish the native vegetation in these different zones. This section includes soil preparation, weed control, erosion control, planting, watering, and plant establishment and maintenance.

**1.02 SUBMITTALS**

- A. Submit shop drawings and other items in accordance with the General Conditions.

**1.03 GUARANTEE**

- A. In June or July of the summer following the fall plantings, the Construction Manager will determine if a satisfactory stand has been established. If not, the Construction Manager will notify the Contractor and reseeding efforts will be scrutinized and again implemented that fall, with associated monitoring the following summer.

**1.04 OBSERVATIONS**

- A. Request observation by the Construction Manager at least 48 hour in advance of the time observation is required.
- B. Observation will be required for the following parts of the work:
1. After completion of grading and soil preparation, and prior to reseeding and plant.
  2. Plant material when delivered to the project site.
  3. When planting and all other indicated or specified work has been completed.
  4. Upon completion of maintenance and plant establishment.

**PART 2 -- PRODUCTS**

**2.01 SEED MIXTURES**

- A. The Diamond Fork seeding mixture for each of these habitat types has been identified in the following tables. All seeding mixes and application rates have been derived from the Interagency Forage and Conservation Planting Guide for Utah (EC433). Seed mixes will be purchased through the USFS or an authorized supplier. All seeds will be furnished in standard containers labeled with seed names, lot numbers, percent species in the mix, net weight, percent purity, germination, and

hard seed and maximum weed seed content.

| UPLANDS                 |                       |                        |                      |                           |
|-------------------------|-----------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name  | Species<br>Latin Name | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses:                |                       |                        |                      |                           |
| Intermediate wheat      | Elymus hispidus       | 15                     | 3                    | 1.10                      |
| Thickspike wheat        | Elymus lanceolatus    | 10                     | 2                    | 0.73                      |
| Great Basin wildrye     | Elymus cinereus       | 10                     | 2                    | 0.72                      |
| Letterman needle        | Stipa letermanii      | 7                      | 1.4                  | 0.51                      |
| Western wheat           | Elymus smithii        | 7                      | 1.4                  | 0.51                      |
| Slender wheat           | Elymus trachycaulus   | 7                      | 1.4                  | 0.51                      |
| Big blue                | Poa ampla             | 5                      | 1                    | 0.37                      |
| Mountain brome          | Bromus carinatus      | 5                      | 1                    | 0.37                      |
| Forbs:                  |                       |                        |                      |                           |
| White sweetclover       | Melilotus alba        | 10                     | 2                    | 0.73                      |
| Chickpea milkvetch      | Astragalus cicer      | 10                     | 2                    | 0.73                      |
| Small burnet            | Sanguisorba minor     | 5                      | 1                    | 0.37                      |
| Palmer's penstemon      | Penstemon palmeri     | 2                      | 0.4                  | 0.15                      |
| Lewis flax              | Linum perenne/lewisii | 2                      | .4                   | 0.15                      |
| Shrubs:                 |                       |                        |                      |                           |
| White Snowberry         | Symphoricarpos albus  | 3                      | 0.6                  | 0.22                      |
| Bitterbrush             | Purshia tridentata    | 2                      | 0.6                  | 0.15                      |
| Total:                  |                       | 100                    | 20                   | 7.35                      |
|                         |                       |                        |                      |                           |
| DIKES                   |                       |                        |                      |                           |
| Species<br>Common Name  | Species<br>Latin Name | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses and Grasslikes: |                       |                        |                      |                           |

|                     |                             |      |     |      |
|---------------------|-----------------------------|------|-----|------|
| Streambank wheat    | <i>Agropyron riparium</i>   | 36.6 | 3   | 1.10 |
| Blue wildrye        | <i>Elymus glaucus</i>       | 24.4 | 2   | 0.73 |
| Western wheat       | <i>Agropyron smithii</i>    | 24.4 | 2   | 0.73 |
| Forbs:              |                             |      |     |      |
| Western yarrow      | <i>Achillea millefolium</i> | 1.2  | 0.1 | 0.04 |
| Northern sweetvetch | <i>Hedysarum boreale</i>    | 12.2 | 1   | 0.37 |
| Pacific aster       | <i>Aster chilensis</i>      | 1.2  | 0.1 | 0.04 |
| Total:              |                             | 100  | 8.2 | 2.98 |

| FLUCTUATING WATER TABLE  |                               |                        |                      |                           |
|--------------------------|-------------------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name   | Species<br>Latin Name         | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| : Grasses and Grasslikes |                               |                        |                      |                           |
| Tufted hair              | <i>Deschampsia caespitosa</i> | 41.7                   | 1                    | 0.37                      |
| Baltic rush              | <i>Juncus balticus</i>        | 4.2                    | 0.1                  | 0.04                      |
| American slough          | <i>Beckmannia syzygachne</i>  | 12.5                   | 0.3                  | 0.11                      |
| Forbs:                   |                               |                        |                      |                           |
| Rocky Mountain Iris      | <i>Iris missouriensis</i>     | 20.8                   | 0.5                  | 0.18                      |
| Golden banner            | <i>Thermopsis montana</i>     | 20.8                   | 0.5                  | 0.18                      |
| Total:                   |                               | 100                    | 2.4                  | 0.88                      |

| PERMANENTLY WET   |                       |                        |                      |                           |
|---|-----------------------|------------------------|----------------------|---------------------------|
| Species<br>Common Name  | Species<br>Latin Name | %/Total<br>Seed<br>Mix | Lbs/<br>Seed<br>Acre | Oz/seed<br>1,000<br>sq/ft |
| Grasses and Grasslikes:   |                       |                        |                      |                           |
| Nebraska sedge  | Carex nebrascensis    | 37.5                   | 3                    | 1.10                      |
| Beaked sedge  | Carex rostrata        | 25                     | 2                    | 0.73                      |
| Baltic rush   | Juncus arcticus       | 37.5                   | 3                    | 1.10                      |
| Forbs:  |                       |                        |                      |                           |
| Forb species not included<br>since most will return<br>naturally with proper<br>care. |                       |                        |                      |                           |
| Total:  |                       | 100                    | 2.4                  | 0.88                      |

## 2.02 HERBICIDE

- A. Prior to application of appropriate seed mix, a USDA Forest Service Pesticide-Use Proposal (Reference PSM 2150) will be filed with the Spanish Fork Ranger District for the application of herbicides for the control of noxious weeds.
- B. Herbicide shall be a Banvel 4-W.S. (4 pounds active ingredient per gallon [lbs ai/gal] and 2, 4-D Ester (4 lbs ai/gal) mixture will be used at 1 pint to 2 quarts Banvel/1-2 quarts 2, 4-D per 99 gallons and applied by backpack sprayer.

## 2.03 WOOD FIBER MULCH

- A. Use wood fiber mulch produced from whole wood chips which have been steamed and defibrated. Wood fiber mulch shall be free of germination or growth inhibiting substances and conform to the following:

|                        |  |
|------------------------|--|
| Moisture content       | 15% maximum of oven dried weight of fibers                                       |
| Organic matter         | 98% minimum of oven dried weight of fibers                                       |
| Ash content            | 1% maximum of oven dried weight of fibers  |
| pH range               | 4.0 to 6.0   |
| Water holding capacity | 10 times oven dried weight of fibers   |
| Fiber length           | 30% minimum at least of 0.16-inches long, 50% minimum retained on 28 mesh screen |

## **2.04 LIQUID TACKIFIER**

- A. Use non-flammable concentrated liquid polymer emulsion with a minimum 60 percent solids. Tackifier should be non-toxic to plants and animals and shall allow water to penetrate soil.

## **2.05 HYDROSEEDING**

- A. The hydroseed mix should be in a slurry having 60 pounds per acre (lb/acre) of tackifier and 400 lb/acre of wood fiber mulch. The tackifier will be derived from natural organic plant sources containing no growth- or germination-inhibiting materials, capable of hydrating in water.
- B. Wood fiber mulch will be processed wood fiber containing no growth- or germination-inhibiting materials, dyed a suitable color to ascertain material placement, and when hydraulically applied to the ground, will allow absorption and percolation of moisture.

## **2.06 PLANT MATERIAL**

- A. Willow plugs are available at the Contractor's expense through the USFS Spanish Fork Ranger District's contracted supplier (Lone Peak Nursery) for native vegetation.

## **2.07 EROSION CONTROL (EXCELSIOR BLANKET)**

- A. The excelsior blanket shall consist of a machine-produced mat of curled wood excelsior of 80 percent, 6-inch or longer fiber evenly distributed over the entire area of the blanket. Fiber dimensions shall be 0.21-inch by 0.42-inches. Average weight per square yard to be 0.08 pound at the time of manufacture.
- B. The top side of each blanket shall be covered with a biodegradable extruded plastic mesh. The blanket shall be made smolder-resistant without the use of chemical additives.
- C. The staples shall be made of wire, 0.091-inch in diameter or greater, "U" shaped with legs 6-inches in length and a 1-inch crown. Size and gauge of staples used may vary with soil conditions and shall be reviewed by the Owner's Representative.
- D. Excelsior blanket shall be by American Excelsior Company, 350 N. Redwood Road, North Salt Lake City, Utah, (801) 292-6060, or approved equal.

## **2.08 STRAW MULCH**

- A. Material for straw mulching shall consist of the straw from oats, barley, wheat, or rye and shall be seed free or fumigated to prevent introduction of weeds. At least 50 percent of the mulch by weight shall be 10-inches or more in length. Old, dry straw which breaks and does not bend is unacceptable.

## **PART 3 -- EXECUTION**

### **3.01 NOXIOUS WEED CONTROL**

- A. Upland areas are defined as all areas 100-feet or more from rivers or other water sources; not shown as wetlands on the drawings.
- B. The disturbed upland areas will be sprayed primarily for the control of musk and Canada thistle. There will be two seasons of spraying; once in May as the thistle rosettes emerge, and once in July/August after bolt, but before seed set. All spraying activity will be coordinated with the Spanish Fork Ranger District and Utah County. Records will be kept indicating treatment rates, treatment locations, acres treated, etc.
- C. In all other areas of disturbance, two mechanical weed removal treatments will be used to control these noxious weeds; once in May as the thistle rosettes emerge, and once in July/August after bolt, but before seed set.

### **3.02 GROUND PREPARATION**

- A. Perform rough grading on slopes to be reseeded to the lines and grades shown on the contract drawings except grading shall be approximately 6-inches below finished grade to allow for placement and spreading of topsoils. Slope ground to drain in agreement with contract drawings. Prepare ground surface for reseeded by restoring topsoils removed during clearing and grubbing and spreading them evenly over the areas to be hydroseeded to minimum depth of 6-inches.
- B. On all areas to be reseeded, roughen the soil surface immediately prior to reseeded. The intent is to create small ledges, cracks and crevices for the seeds to lodge in and reduce erosion. These created depressions and ledges will also provide shelter for small seedlings and increase water infiltration/retention and root penetration.
- C. On slopes steeper than 3:1, rake soils perpendicular to the slope or run bulldozer tracks up and down the slope to create small horizontal ledges for the seedbed. This final "pass" with the dozer or rake is of critical importance in creating an adequate seedbed and controlling erosion. Where slopes are flatter than 3:1, use a disk or similar equipment to roughen the topsoil in furrows perpendicular to the slope.

### **3.03 AREAS NOT REQUIRING 6-INCHES OF TOPSOIL AND RESEEDING**

- A. All areas disturbed by construction shall receive a 6-inch minimum thickness of topsoil (stockpiled during clearing and grubbing) and shall be reseeded with one of the four specified seed mixtures except in the areas listed below:
  - 1. On the hard rock cut slopes list in paragraph 3.05.
  - 2. On road pavement and road shoulders to edge of shoulder.
  - 3. On minor approach roads to edge of shoulder.
  - 4. On riprap.

**3.04 REPLACEMENT OF HERBACEOUS SPECIES**

- A. All reseeding efforts shall be conducted in November; later if snow conditions permit. On all upland areas, the areas to be reseeded will be prepared by mechanically disturbing the soil immediately before seeding. Additionally, after seeding, the soil shall be mechanically treated in the same fashion. Seeds shall be broadcast at rates as indicated in the tables.
- B. In all other habitat types, the areas will be reseeded without any seedbed preparation. At river crossings and at any areas within 100-feet of free water which may be erosional, seeds will be hydroseeded. After application of seed hydromix, another application will be made with slurry containing only tackifier (60 lb/acre) and wood fiber mulch (1,500 lb/acre).

**3.05 INSTALLATION OF EROSION CONTROL (EXCELSIOR) BLANKET**

- A. Areas to Receive Excelsior Blanket. Apply erosion control blanket on all disturbed slopes steeper than 2.5:1 except the hard rock road cut (not fill) slopes listed below by road station:

| Station to Station | Cut Slope | Bedrock Material |
|--------------------|-----------|------------------|
| R20+00 to R22+00   | 0.5:1     | Sandstone        |
| R141+00 to R145+00 | 0.5:1     | Conglomerate     |
| R185+00 to R195+00 | 1:1       | Conglomerate     |
| R207+00 to R214+00 | 1:1       | Limestone        |
| R215+50 to R229+00 | 1:1       | Limestone        |

- B. Excelsior Blanket Installation. Complete all soil preparation and seeding in areas to receive erosion control blanket before placing blanket. Apply erosion control blanket within 5 calendar days after seeding and before precipitation falls. Install blanket per manufacturer's instructions with correct side up. Do not stretch the blanket. Allow it to lie loosely on the soil to achieve maximum soil contact. Horizontal seams within 15-feet of the top of the slope are not permitted. Do not tear or rip the blanket during installation. Staple the blanket per manufacturer's specifications. Staple requirements vary according to steepness and length of slope. Place additional staples in areas such as swales, against rock outcroppings and as required to provide blanket to ground contact.
- C. Deliver all seed to the project site unmixed and in sealed containers. Label all seed according to state and federal seed laws with each container bearing the seed suppliers tags indicating the container weight, seed type (genus and species), seed purity percent, seed germination percent and date seed was tested. A sample of each seed type shall be collected at the time of delivery to the site by the Construction Manager. Samples will be tested to assure compliance with the seed specifications.
- D. Conduct all reseeding in the months of November or December to take advantage of winter moisture and assure the success of revegetation. Do not apply hydroseed during windy, rainy or snowy conditions or when the ground temperature is below 45 degrees Fahrenheit.

**3.06 REPLACEMENT OF WOODY VEGETATION (WILLOWS)**

- A. During construction through riparian areas with woody vegetation (especially willows), the vegetation and the soil in which the vegetation is growing will be removed by the backhoe and stockpiled. These clumps of woody vegetation will be incorporated into the revegetation of woody areas. If this is not feasible, new seedlings may be used.
- B. Following the application of erosion control material, either the large aggregates of woody vegetation and soil that were removed previously and temporarily stored in the shallows, or cuttings of Yellow willow (*Salix lutea*) and Coyote willow (*Salix exigua*) supplied by the USFS's contracted supplier, will be placed over the matting. Cuttings will be spaced on 6-foot centers and in all areas where woody vegetation grew prior to construction activities.

### **3.07 SITE PROTECTION**

- A. Construct a 4-foot high fence built of 4-inch by 4-inch square wire and tuber pole mesh along all riparian areas which have been revegetated. Additionally, a similar fence will be constructed along the pipeline in areas designated by the Construction Manager that may tempt vehicular exploration. Signs explaining the revegetation efforts will be erected.
- B. Remove all protective fencing following establishment of the reseeding effort, at the direction of the Construction Manager.

\*\*\* END OF SECTION \*\*\*

## SECTION 02925

### TOPSOIL

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to strip topsoil from designated areas and place in a stockpile. Work shall also include spreading of topsoil from the stockpiles onto prepared areas.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02933 – Seeding.

#### **PART 2 -- PRODUCTS**

##### **2.01 TOPSOIL**

- A. Obtain from on-site locations.

#### **PART 3 -- EXECUTION**

##### **3.01 STANDARD PROCEDURES**

- A. Place topsoil just before seeding when possible.
- B. Do not place topsoil if it cannot be seeded within the seeding window specified in the Contract Documents.
- C. Do not strip or handle topsoil when wet or frozen.
- D. Work topsoil only when it can be left in a friable, loose and crumbly state.

##### **3.02 STRIP AND STOCKPILE TOPSOIL**

- A. Strip topsoil only from areas identified on the plans and approved by the Engineer.
- B. Remove vegetation greater than 2-inches in diameter and taller than 4-feet and rocks larger than 2-inches in diameter from the area to be stripped.
- C. Strip the topsoil along with the remaining vegetation to a depth of 12-inches except in drainage basins where topsoil is expected to be 2 to 3 feet thick.
- D. Remove and dispose of any roots larger than 2-inches in diameter or longer than 12-inches.
- E. Stockpile topsoil in approved locations per the Contract Documents.
- F. Grade to minimize any erosion on and around the stockpiles.

\*\*\* END OF SECTION \*\*\*

## SECTION 02933

### SEEDING

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Furnish all labor, materials and equipment as required to apply seed. This includes but is not limited to preparing ground, sowing, seeds and other management practices on areas shown on the project drawings and in accordance with this specification.

##### **1.02 RELATED WORK AND REFERENCES**

- A. Section 02925 – Topsoil

##### **1.03 DEFINITIONS**

- A. A *sandy* soil is one with a USDA soil texture classification of any of the following: sand, loamy sand, sandy clay loam, or a sandy clay.
- B. A *non-sandy* soil is one with a USDA soil texture classification of any of the following: loam, silt loam, silt, clay loam, silty clay loam, silty clay, or clay.

#### **PART 2 -- PRODUCTS**

##### **2.01 SEED**

- A. Supply seed on a pure live seed (PLS) basis.
- B. Meet the Utah Seed Act.
- C. Provide inoculated legume seed.
- D. Each variety of seed shall be furnished and delivered in separate bags or containers. Provide germination or tetrazolium test data for each variety of seed. Date of tests shall be within nine months of the time of seeding.

##### **2.02 EROSION CONTROL MULCH AND MAT**

- A. Straw mulch – Straw mulch shall be oat, wheat or rice straw. The straw mulch shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted.
- B. Erosion control mat – Provide as described in Section 02272 – Fabric, Erosion Control Mats and Geotextiles.

## **PART 3 -- EXECUTION**

### **3.01 GENERAL**

- A. Do not use wet, moldy or damaged seed.
- B. Notify City two working days prior to seeding.
- C. Complete all seeding on or before September 15 of the year in which the seeding is to be completed.

### **3.02 SECURE SEED**

- A. Submit seed certification based on PLS and results of germination tests. The purchase order should list the common and botanical name for each seed species.
- B. Place and compact the entire width of the berm in accordance with Section 02292.

### **3.03 SEED SUBSTITUTIONS**

- A. Before requesting a seed substitution, contact the major seed companies in the state to verify that the seed is unavailable.
- B. Have the Engineer contact the Landscape Architect, who developed the seed mix, to verify the seed is unavailable and to recommend a seed substitution.
- C. Replacement seed shall be of equal or greater function to the originally specified seed.
- D. Place drains at maximum intervals of 1,000-feet along a continuous slope.

### **3.04 MIXING SEED**

- A. Mix and bag the different varieties of seed in the presence of the City.
- B. Obtain the seed from the same lots from where it was sampled.
- C. Mix the different seed varieties to provide an even blend.
- D. Bag the mixed seed and label and seal the container.

### **3.05 SEED APPLICATION RATES PER ACRE**

- A. Seed all areas using the appropriate seed mix listed in the following tables according to location and/or soil conditions. The rates listed in the table are for broadcast seeding. For drill seeding, reduce the rates by 1/3.

| <b>DITCH SEED MIX<br/>- ALL SOILS</b> |                       |                      |                                 |
|---------------------------------------|-----------------------|----------------------|---------------------------------|
| <i>Common Name</i>                    | <i>Botanical Name</i> | <i>Form</i>          | <i>Rate<br/>(lbs/acre, PLS)</i> |
| Ephraim Crested Wheatgrass            | Agropyron cristatum   | Slightly Rhyzomatous | 8.0                             |
| Sodar Streambank Wheatgrass           | Bromus inermis        |                      | 16.0                            |
| Western Wheatgrass                    | Elymus smithii        | Strongly Rhyzomatous | 6.0                             |
| Covar Sheep Fescue                    | Festuca ovina         | Bunch                | 6.0                             |
| Perennial Ryegrass                    | Lolium perenne        |                      | 4.0                             |
| Total =                               |                       |                      | 40 lbs/acre                     |

| SEED MIX<br>- SANDY SOILS        |                                 |                     |                                 |
|----------------------------------|---------------------------------|---------------------|---------------------------------|
| <i>Common Name</i>               | <i>Botanical Name</i>           | <i>Form</i>         | <i>Rate<br/>(lbs/acre, PLS)</i> |
| Crested Wheatgrass "Hycrest"     | <i>Agrophron cristatum</i>      | Bunch               | 5.0                             |
| Bluebunch Wheatgrass "Secar"     | <i>Elymus spicatus</i>          | Bunch               | 3.5                             |
| Western Wheatgrass               | <i>Elymus smithii</i>           | Stongly Rhyzomatous | 3.5                             |
| Sheep Fescue "Covar"             | <i>Festuca ovina</i>            | Bunch               | 2.5                             |
| Indian Ricegrass                 | <i>Stipa hymenoides</i>         | Bunch               | 2.5                             |
| Intermediate Wheatgrass "Tegmar" | <i>Elymus hispidus</i>          | Mild sod forming    | 4.5                             |
| Thickspike Wheatgrass            | <i>Elymus lanceolatus</i>       | Sod forming         | 2.5                             |
| Great Basin Wildrye              | <i>Elymus cinereus</i>          | Slightly spreading  | 2.5                             |
| Blue Flax                        | <i>Linum perenne</i>            | Wildflower          | 1.5                             |
| Light Evening Primrose           |                                 | Wildflower          | 0.5                             |
| California Poppy                 | <i>Eschscholzia californica</i> | Wildflower          | 1.0                             |
|                                  |                                 |                     | Total = 29.5 lbs/acre           |

| SEED MIX<br>- NON-SANDY SOILS    |                                 |                         |                                 |
|----------------------------------|---------------------------------|-------------------------|---------------------------------|
| <i>Common Name</i>               | <i>Botanical Name</i>           | <i>Form</i>             | <i>Rate<br/>(lbs/acre, PLS)</i> |
| Crested Wheatgrass "Ephraim"     | <i>Agrophron cristatum</i>      | Slightly Rhyzomatous    | 4.5                             |
| Smooth Brome                     | <i>Bromus inermis</i>           | Soil forming            | 4.5                             |
| Intermediate Wheatgrass "Tegmar" | <i>Elymus hispdus</i>           | Mild sod forming        | 4.5                             |
| Great Basin Wildrye              | <i>Elymus cinereus</i>          | Slightly spreading      | 2.5                             |
| Russian Wildrye                  | <i>Elymus junceus</i>           | Bunch                   | 3.5                             |
| Western Wheatgrass               | <i>Elymus smithii</i>           | Strongly<br>Rhyzomatous | 2.5                             |
| Slender Wheatgrass               | <i>Elymus trachycaulus</i>      | Bunch                   | 2.5                             |
| Utah Sweet Vetch                 |                                 | Spreading (legume)      | 2.0                             |
| Blue Flax                        | <i>Linum perenne</i>            | Wildflower              | 1.5                             |
| Light Evening Primrose           |                                 | Wildflower              | 1.0                             |
| California Poppy                 | <i>Eschscholzia californica</i> | Wildflower              | 1.0                             |
|                                  |                                 |                         | Total = 30.0 lbs/acre           |

### 3.06 SEED BED PREPARATION

- A. Do not work topsoil or seed when the soil is saturated or frozen.
- B. If a crust has formed on the topsoil, loosen the ground surface to a depth of one-inch.
- C. If the topsoil has produced weeds, remove them before seeding.
- D. Prior to seeding, moisten the soil to a depth of 6 to 8-inches.

### 3.07 METHODS

- A. Drill seeding
  - 1. Use the drill method of seeding accessible slopes 3:1 and flatter. Use a rangeland type drill equipped with a depth band, seed box agitator, seed metering device, furrow opener and packer wheels.
  - 2. Calibrate the drill using the manufacturer's directions in the presence of the City.
  - 3. Meet the specified application rate.
  - 4. Space drill rows 6 to 8-inches and drill seeds 3/8-inch to 1/2 -inch in depth.
  - 5. Drill along the contour of the slope.
  - 6. Maintain the drill at the calibrated setting throughout the seeding operation.
  
- B. Broadcast seeding
  - 1. Use the broadcast method of seeding on all areas that were not drill seeded.
  - 2. If seed is to be hand broadcast, it shall be broadcast in two directions at right angle to each other.
  - 3. Rake seed into the soil perpendicular to the slope.

### **3.08 EROSION CONTROL MULCH**

- A. On slopes of 3:1 and flatter, apply straw mulch with a minimum stalk length of 8-inches and a minimum rate of 3,000-pounds per acre.
- B. The moisture content of the straw shall not be greater than 20-percent.
- C. Anchor the straw mulch into the soil by the crimping method.

### **3.09 TIMING**

- A. All seeding and slope stability measures shall be in place no later than 3 weeks after topsoil has been placed to finished grade.

### **3.10 INSPECTION**

- A. Following the completion of the initial revegetation, the City will inspect the work to be certain that installation is as per supplier and/or manufacturer's recommendations.
  
- B. If the work is not approved, the Contractor shall replant and/or reseed and/or stabilize all areas within the initial area of disturbance and take all other actions reasonably necessary as directed by the City to provide erosion control and slope and/or area stabilization within the initial area of disturbance.

### **3.11 WARRANTY PERIOD**

- A. A 36-month warranty period (the "Warranty Period") shall commence after the City approves work. At the end of the warranty period, the City will make an inspection to determine whether or not the revegetation growth has taken hold and the disturbed areas are established and stabilized, i.e. lack of rill or gully erosion.
  
- B. The technical procedure in determining if the vegetation has been established enough to stabilize the soils against either rill or gully erosion, is the quadrant frame method, or the step transect method. Both methods are a way of comparing plant production, biomass cover and erosion in the revegetated

area with the same in an adjacent undisturbed and/or native site. Either method will be performed at several randomly selected locations at the project.

- C. If, at the end of the warranty period, the City determines that the vegetation is unsatisfactory, the Contractor shall install new measures or repair the old measures as directed by the City.

\*\*\* END OF SECTION \*\*\*

## SECTION 03100A

### CONCRETE FORMWORK

#### PART 1—GENERAL

##### 1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish all materials for concrete formwork, bracing, shoring, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Contractor Submittals
- B. Section 03200 - Reinforcement Steel
- C. Section 03300 - Cast-in-Place Concrete
- D. Precast Concrete Specialties. 03480

##### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes:
- 1. The Building Code, as referenced herein, shall be the Uniform Building Code (UBC), as specified in section entitled, "Reference Standards." 01090
- B. Government Standards:
- 1. PS 1-74 U.S. Product Standard for Concrete Forms, Class I.
- C. Commercial Standards:
- 1. ACI 347-78 Recommended Practice for Concrete Formwork.

##### 1.04 CONTRACTOR SUBMITTALS

- A. Falsework Calculations and Drawings: The Contractor's attention is directed to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil engineer, registered in the State of Utah; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.
- B. The CONTRACTOR shall, in accordance with the requirements in Section entitled "Contractor Submittals," 01300 submit detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes and members, anticipated stresses, grade of materials to be used in the falsework, and typical soil conditions.

## 1.05 QUALITY ASSURANCE

- A. **Tolerances:** The variation from established grade or lines shall not exceed 1/4-inch in 10-feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the "Suggested Tolerances" specified in Section 203 of ACI 347.

## **PART 2 – PRODUCTS**

### 2.01 GENERAL

- A. Except as otherwise expressly accepted by the ENGINEER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:
1. Walls - Steel or plywood panel
  2. Columns - Steel, plywood or fiber glass plywood
  3. Roof and floor slabs - Plywood
  4. All other work - Steel panels, plywood or tongue and groove lumber

### 2.02 FORM AND FALSEWORK MATERIALS

- A. Materials for concrete forms, formwork, and falsework shall conform to the following specifications:
1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
  2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured, especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
  3. Form materials shall be plywood or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade as shown. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Exterior Grade.
- B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.
- C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 30 psf minimum.

### 2.03 FORM TIES

- A. Form ties with integral water stops shall be provided with a plastic cone or other suitable means of forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable for-tie fasteners having a circular cross-section, shall not exceed 1-1/2-inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
- B. Form ties for water-retaining structures shall have integral water stops. Removable taper ties may be

used when approved by the ENGINEER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

### **PART 3 -- EXECUTION**

#### **3.01 GENERAL**

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

#### **3.02 FORM DESIGN**

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studs if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of the wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the ENGINEER.

#### **3.03 CONSTRUCTION**

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of

comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties:

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section entitled "Cast-in-Place Concrete." 03300 Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face of faces of the concrete.
2. Removable Ties: Where taper ties are approved for used, the larger end of the taper tie shall be on the wet side of walls, in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plumb shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls, which are dry on both sides. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

### 3.04 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces, which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

### 3.05 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section entitled, "Cast-in-Place Concrete"; 03300 provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent

panel or until has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by the ENGINEER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the WORK not specifically mentioned herein shall remain in place for periods of time as determined by the ENGINEER.

### **3.06 MAINTENANCE OF FORMS**

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the ENGINEER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

### **3.07 FALSEWORK**

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements specified herein.
- B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.
- C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure, which already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

\*\*\* END OF SECTION \*\*\*

## SECTION 03102

### GENERAL CONCRETE CONSTRUCTION

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. This section includes materials, installation, and testing of formwork, reinforcing steel, joints, concrete, insulation, and finishing and curing for general concrete construction.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 09820 - Crystalline Waterproofing
- B. Section 09900 - Painting and Coating
- C. Section 15142 - Wall Pipes, Seep Rings, and Penetrations

##### **1.03 SUBMITTALS**

- A. Submit shop drawings in accordance with the Contract Documents.
- B. Submit manufacturer's catalog data and descriptive literature for form ties, spreaders, corner forms, form coatings and curing compound, bond breakers, joint sealant, backing rod, joint filler, control joints, epoxy bonding compound, and floor hardener.
- C. Submit mill test certificates identifying chemical and physical analyses of each load of reinforcing steel delivered. If mill test reports are unavailable and the quantity of steel for a structure exceeds 5 tons, provide a laboratory test to prove conformance with the specified ASTM standard.
- D. Submit reinforcing bending lists and placing drawings for all reinforcing. Placing drawings shall indicate all openings (mechanical, electrical, equipment, and architectural) including additional reinforcing at openings and corner bar arrangements at intersecting beams, walls, and footings indicated in the typical detail and structural drawings. Placing drawings shall be coordinated with the concrete placing schedule. Each bending list and placing drawing submitted shall be complete for each major element of a structure (grade slabs, footings, walls, deck, floor, or roof slabs) including dowels and corner bars. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified.
- E. Submit concrete mix design at least 15 days before placing concrete.
- F. Submit insulation manufacturer's product data sheets confirming compliance with the physical properties specified herein, CFC compliance certification and 15-year limited thermal warranty certificate, samples of specified insulation, and adhesive manufacturer's product information confirming compatibility with polystyrene insulation.

## **PART 2 -- PRODUCTS**

### **2.01 FORMWORK**

- A. Design forms according to ACI 347.
- B. Class I Forms. Use steel forms, ply form, or smooth-surface plywood 3/4-inch minimum thickness for straight surfaces and 1/2-inch minimum thickness for curved surfaces.
- C. Class II Forms. Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints. Forms shall be oiled.
- D. Class II forms may be used for exterior concrete surfaces, which are 1-foot, or more below finished grade. Use Class I forms for all other surfaces.

### **2.02 BOND BREAKER**

- A. Bond breaker shall be a nonstaining type which will provide a positive bond prevention, such as Williams Tilt-Up Compound, as manufactured by Williams Distributors, Inc., Seattle, Washington; Silcoseal 77, as manufactured by SCA Construction Supply Division, Superior Concrete Accessories, Franklin Park, Illinois; or approved equal.

### **2.03 FORM RELEASE AGENT**

- A. Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agency shall be nonstaining and nontoxic after 30 days.
- B. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

### **2.04 REINFORCING STEEL**

- A. Reinforcement shall conform to ASTM A615, Grade 60.
- B. Fabricate reinforcing in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute. Bend reinforcing steel cold.
- C. Deliver reinforcing steel to the site bundled and tagged with identifying tags.

### **2.05 WELDED WIRE FABRIC**

- A. Welded wire fabric shall conform to ASTM A185.

### **2.06 TIE WIRE**

- A. Tie wire shall be 16-gauge minimum, black, soft, annealed.

## 2.07 BAR SUPPORTS

- A. Bar supports in beams and slabs exposed to view after form stripping shall be galvanized and plastic coated. Use concrete supports for reinforcing in concrete placed on grade.

## 2.08 BAR COUPLERS

- A. Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice Inc. or approved equal. Use couplers, which do not reduce tensile or ultimate strength of bars.

## 2.09 JOINT SEALANT

- A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall be RC 270 of Products Research and Chemical Corporation, Mameco International Vulkem 227, Multi-Chem Mc287, or approval equal.

| TECHNICAL REQUIREMENTS      |   |
|-----------------------------|---|
| Consistency                 | Gun grade   |
| Tack free time              | 24-hours at 75 degrees F and 50% R.H.             |
| Pot life                    | 1 to 3 hours                                      |
| Hardness                    | 35 Shore A,5                                      |
| Elongation                  | 700%  |
| Tensile strength, ASTM D412 | 300 psi   |
| Peel strength on concrete   | No loss of bond after 24 hours at 150% elongation |
| Temperature service range   | -40 degrees F to +175 degrees F                   |
| Immersion in water          | Continuous  |

## 2.10 BACKING ROD FOR EXPANSION JOINTS

- A. Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam SB, as manufactured by Dow Chemical Company, Midland, Michigan; or approved equal. The rod shall be 1/4-inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.

## **2.11 BOND BREAKER TAPE**

- A. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape, which will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

## **2.12 PREFORMED CONTROL JOINT**

- A. Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip, KSF-150-5--5-, manufactured by Vinylex Corp., Knoxville, Tennessee, or a one-piece steel strip with preformed groove, such as Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, California, or approved equal. Provide the preformed control joint material in full-length unspliced pieces.

## **2.13 PREMOLDED JOINT FILLER**

- A. Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D 1752, Type I, as manufactured by W.R. Grace Company of Cambridge, Massachusetts; W.R. Meadows, Inc., Elgin, Illinois; or equal.

## **2.14 STEEL EXPANSION JOINT DOWELS**

- A. Steel expansion joint dowels shall conform to one of the following:
  - 1. Epoxy coated steel bar dowels with a 12-mil coating thickness. Steel bar dowels shall conform to ASTM A 36 or ASTM 615, plain rounds, Grade 40. Epoxy coating shall be in conformance with ASTM A 775; or approve equal.
  - 2. Stainless steel bar dowels conforming to ASTM A 276, Type 302.
- B. Exposed portion of expansion joint dowels shall be thoroughly greased prior to casting or adjoining wall or slab.

## **2.15 CEMENT**

- A. Cement shall conform to ASTM C150, Type II, with maximum tricalcium aluminate not to exceed 8 percent and shall be from a prequalified producer of cement (Corps of Engineers specifications). The maximum percent alkalis shall not exceed 0.6 percent.

## **2.16 AGGREGATES**

- A. Aggregates shall comply with ASTM C33 and shall contain less than 1 percent asbestos by weight or volume and be free from any substances, which will react with cement alkalis.

## **2.17 CONCRETE ADMIXTURES**

- A. Concrete shall contain an air-entraining admixture. Admixture shall conform to ASTM C260, except it shall be nontoxic after 30 days and shall contain no chlorides. Admixtures shall be Master Builders MB-AE 10, Sika AER (Sikamix 104), or approved equal.

- B. Concrete shall contain a water-reducing admixture. The admixture shall conform to ASTM C494, Type A or D except it shall contain no chlorides, shall be nontoxic after 30 days, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations. Admixtures shall be Master Builders Pozzoloth polymer-type normal setting, Plastocrete (Sikamix 160) Normal Set, Sika Chemical Corporation, or approved equal.
- C. Do not use any admixture, which contains chlorides or other corrosive elements in any concrete.

**2.18 GROUT**

- A. Nonshrink grout shall conform to the Corps of Engineers Specification for Nonshrink Grout, CRD-C621-83, and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 713, or approved equal. Components shall be inorganic.
- B. Ordinary type grout (dry pack) shall consist of one part portland cement to two parts sand (100 percent passing a No. 8 sieve). Add sufficient water to form a damp formable consistency.
- C. Expansive Grout. Premixed, cementations mixture with a minimum 28-day strength of 3,500 psi. Provide air-entraining content as recommended by the manufacturer.
- D. Epoxy Grout.
  - 1. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions.
  - 2. Use sand, which is oven dry and meets the following gradation requirements for epoxy grout:

| Sieve Size | No. 8 | No. 50 | No. 100 |
|------------|-------|--------|---------|
| % Passing  | 100   | 30-15  | 55      |

**2.19 MORTAR**

- A. Mortar or grout placed on horizontal construction joints shall be a mixture of cement, sand, and water in the same proportions used in the concrete but with coarse aggregate omitted.
- B. Mortar used for repair of concrete shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

**2.20 BONDING COMPOUND**

- A. Epoxy bonding compound shall be Concessive 1001 LPL, Adhesive Engineering Company, San Carlos, California; Sikadur Hi-Mod (Sikastix 370), Sika Chemical Corporation, Lyndhurst, New Jersey; Epoxtile 2391 by W.R. Grace and Company; Euco Epoxy 463 by Euclid Chemical Company; or approved equal.

- B. Nonepoxy bonding compound shall be Weldcrete by Larsen Products Corporation, Link by Sta-Dry Manufacturing Corp., Euco Weld by Euclid Chemical Company, or approved equal. The compound shall be rewettable for up to two weeks.

**2.21 CONCRETE MIX DESIGN**

- A. Conform to ASTM C94, except as modified by these specifications.  
 B. Air content as determined by ASTM C231 shall be 4 percent to 1 percent.  
 C. Maximum water-cement ratio for Class A concrete shall be equal to 0.45 by weight.  
 D. Use classes of concrete as described in the following table:

| Class | Type of Work   | 28-Day Compressive Strength (psi) | Minimum Cement Content (lbs/c.y.) |
|-------|--|-----------------------------------|-----------------------------------|
| A     | Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, cradle, supports across pipe trenches. | 4,000                             | 564                               |
| B     | Pavement   | 3,000                             | 500                               |
| C     | Floor grout, miscellaneous unreinforced concrete.  | 2,000                             | 376                               |

- E. Measure slump in accordance with ASTM C143. Slump shall be as follows:

|  |               |
|--|---------------|
| Slab on grade or heavy sections wider (in plan view) than 3-feet | 3-inches max. |
| Footings, walls, suspended slabs, beams, and columns             | 4-inches max. |
| Pavement   | 2-inches max. |

Proportion and produce the concrete to have a maximum slump as shown. A tolerance of up to 1-inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

- F. Aggregate size shall be 3/4-inch maximum for slabs and sections 8-inches thick and less. Aggregate size shall be 1-inch maximum for slabs and sections greater than 8-inches and smaller than 17-inches. Aggregate size shall be 1 1/2 inches maximum for all larger slabs and sections.
- G. Combined aggregate grading shall be as shown in the following table:

|                              | Maximum Aggregate Size |        |          |
|------------------------------|------------------------|--------|----------|
|                              | 1 1/2-inch             | 1-inch | 3/4-inch |
| Aggregate Grade per ASTM C33 | 467                    | 57     | 67       |

H. Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

## 2.22 CONCRETE TESTS

A. Perform concrete quality testing on the concrete as follows:

1. Frequency of Sampling. Cast four concrete test cylinders from each 50 cubic yards of concrete, or fraction thereof, of each class of concrete placed in any one day. Sampling and curing of cylinders shall conform to ASTM C 31.
2. Strength Testing. Test cylinders in accordance with ASTM C 39. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.
3. Determine concrete slump by ASTM C 143 with each strength test sampling and as required to establish consistency.
4. Determine air content of the concrete using ASTM C 231 to verify the percentages of air in the concrete immediately prior to depositing in forms.
5. The average value of concrete strength tests shall be equal to or greater than the specified 28-day strength. Non-test shall be less than 90-percent of the specified 28-day strength.
6. If the 28-day strength tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be defective and one set of three cores from each area may be taken as selected by the Construction Manager and in accordance with ASTM C42. If the average compressive strength of the set of three concrete cores fails to equal 90-percent of the specified minimum compressive strength or if any single core is less 75-percent of the minimum compressive strength, the concrete will be considered defective. The Owner may require additional coring, nondestructive load testing, or repair or removal of defective concrete. Costs of coring, testing of cores, load testing, and required repairing pertaining thereto shall be paid by the Contractor at no extra cost to the Owner.

B. To facilitate any Construction Manager-concrete sampling and testing;

1. Furnish labor to assist the Construction Manager in obtaining and handling samples at the project site.
2. Advise the Construction Manager in advance of concrete placing operations to allow for scheduling and completion of quality testing.
3. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

## 2.23 CURING COMPOUND

- A. Curing compound shall conform to ASTM C309, Type 1 or 1-D, Class B.
- B. Curing compound shall be compatible with required finishes and coatings.

**2.24 RIGID INSULATION**

- A. The insulation shall be 2-inch thick, HCFC-blown, extruded polystyrene with an R-value of 5-hour foot squared degree F/BTU per inch. The insulation shall meet ASTM C578, Type IV (25 psi). Insulation shall be STYROFOAM brand Square Edge insulation as manufactured by Dow Chemical, or approved equal.
- B. The insulation shall be manufactured with a blowing agent, which provides at least 90-percent reduction in ozone depletion potential compared to standard CFC blowing agents. Other insulations are not acceptable.
- C. The insulation shall be new, free from defects, and of uniform color.
- D. The insulation shall have a limited thermal warranty stating that the R-value will not deviate more than 10-percent from its published value for a period of 15 years from the manufacturing date printed on the insulation boards.

**2.25 ADHESIVE**

- A. Adhesive shall be as recommended by insulation manufacturer for use with polystyrene foam. Adhesive shall be formulated specifically to bond insulation to steel and concrete surfaces.

**PART 3 -- EXECUTION**

**3.01 FORM TOLERANCES**

- A. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.
- B. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

|  |         |
|--|---------|
|  | Maximum |
|--|---------|

|                                  | Tolerance                                       |
|----------------------------------|---|
| Sleeves and inserts              | +1/4" -1/4"                                     |
| Projected ends of anchors        | +1/4" -1/4"                                     |
| Anchor bolt setting              | +1/4" -1/4"                                     |
| Finished concrete, all locations | +1/4" -1/4" in 10-foot max., 1" in total length |

The planes or axes from which the above tolerances are to be measured shall be as follows:

|                            |  |
|----------------------------|--|
| Sleeves and inserts:       | Centerline of sleeve or insert.  |
| Projected ends of anchors: | Plane perpendicular to the end of the anchor as located on the drawings. |
| Anchor bolt setting:       | Centerline of anchor bolt.   |
| Finish concrete:           | The concrete surface as located on the drawings.                         |

Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

### 3.02 FORM SURFACE PREPARATION

- A. Clean form surfaces to be in contact with concrete of foreign material prior to installation.
- B. Coat form surfaces in contact with concrete with a release agent prior to form installation.

### 3.03 FORM REUSE

- A. Reuse only forms, which provide a uniform surface texture on exposed concrete surfaces. Apply light sanding or other surface treatment between uses for uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side. Do not patch forms other than filling tie rod holes, except in the case of Class II forms, do not use metal patching discuss on Class I forms.

### 3.04 REMOVAL OF FORMS

- A. Forms and shoring for elevation structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed.

|  |  |
|--|--|
| Sides of footings and encasements  | 24 hours   |
| Walls, vertical sides of beams, girders, columns, and similar members not supporting loads | 48 hours   |
| Slabs, beams, and girders  | 10 days (forms only)   |
| Shoring for slabs, beams, and girders  | Until concrete strength reaches specified 28-day strength        |
| Wall bracing   | Until to or roof slab concrete reaches specified 28-day strength |

- B. Do not remove forms from concrete, which have been placed with outside air temperature below 50 degrees F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

### 3.05 FORMED OPENINGS

- A. Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure water tightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2-inches clear from the opening surfaces and encased items.

### 3.06 EMBEDDED ITEMS

- A. Set anchor bolts and other embedded items accurately and hold securely in position until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check all nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concreting.

### 3.07 BEVELED EDGES (CHAMFER)

- A. Form 3/4-inch beveled edges on exposed concrete edges and corners, beam soffit corners, and where indicated on the drawings. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the drawings. The top edges of slabs, walkways, beams, and wall may be beveled with an edging trowel in lieu of using chamfer strips.

### 3.08 CONSTRUCTION JOINTS

- A. Provide construction joints in accordance with the following:
1. **Slabs.** Maximum spacing of 40-feet on center in each direction in plan.
  2. **Retaining Walls.** Maximum spacing of 50-feet on center (vertical joints).

3. Box-Shaped (in plan) Structure (not culverts). Maximum total length of wall without construction joints is 80-feet.
4. Box Culverts. Maximum spacing of 50-feet for wall and slab joints transverse to the longitudinal axis of the culvert.

For purposes of maximum spacing requirements, expansion joints are considered to be construction joints.

- B. Layout of construction joints shall be shown in the drawings and according to the following guidelines:
  1. Provide horizontal construction joints at top of foundation members and slabs-on-grade and at the soffit of supported slabs and beams.
  2. Space the construction joints at a maximum horizontal distance of 25-feet and a maximum vertical distance of 16-feet.
  3. Space the corner vertical construction joints between 4 and 8-feet from the corner of walls or wall intersections.
  4. Space horizontal construction joints at least 8-inches below bottom of slabs.
- C. Construction joints shall be keyed, unless otherwise detailed. Form keyways by beveled strips or boards placed at right angles to the direction of shear. Except where otherwise shown on the drawings or specified, keyways shall be at least 1 1/2-inches in depth over at least 25-percent of the area of the section.
- D. When it is necessary to make a joint because of an emergency, furnish and place reinforcing dowels across the joint. Embed dowels 48 bar diameters each side of the joint. Size and number of dowels shall match reinforcing in the member. Furnishing and placing such reinforcing steel shall be at the Contractor's expense.
- E. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material, and expose clean aggregate by sandblasting the surface of construction joints before placing the new concrete. Cover horizontal construction joints with mortar, spread uniformly and work thoroughly into all irregularities of the surface. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed, and the consistency of the mortar shall be suitable for placing and working.
- F. In case of emergency, place additional construction joints. (An interval of 45 minutes constitutes cause for an emergency construction joint.)

### **3.09 EXPANSION JOINTS**

- A. Provide expansion joints with continuous edge reservoirs, which shall be filled with a joint sealant. Leave the material used for forming the reservoirs in place until immediately before the grooves are cleaned and filled with joint sealant. After removing edge forms from the reservoir, remove grout, loose concrete, and fill; then sandblast the slots. Allow the reservoir to become thoroughly dry; then flow out the reservoir and immediately prime and fill with the expansion joint sealant and backup materials. The primer used shall be supplied by the same manufacturer supply the joint sealant.

### **3.10 TIME BETWEEN CONCRETE POURS**

- A. At least 2-hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise indicated on the drawings.

### **3.11 INSTALLATION OF PREMOLDED JOINT FILLER**

- A. Install in joint accurately as shown. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

### **3.12 INSTALLATION OF JOINT SEALANTS**

- A. Install in joint accurately as shown. Attached to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.
- B. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
- C. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck-pointing tool wiped with a solvent recommended by the sealant manufacturer.
- D. After the sealant has been applied, remove the masking tape and any sealant spillage.

### **3.13 INSTALLATION OF STEEL EXPANSION JOINT DOWELS**

- A. Install parallel to wall or slab face, perpendicular to the joint face, and in true horizontal position. Secure tightly in forms with rigid ties, Orient dowels to permit joint movement.

### **3.14 PLACING REINFORCEMENT**

- A. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.
- B. Place reinforcing in accordance with the following, unless otherwise indicated:
  - 1. Reinforcement indicated on the drawings is continuous through the structure to the farthest extent possible. Terminate bars 2-inches clear from faces of concrete.
  - 2. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 40 feet. Splicing of reinforcement, which is detailed to be continuous on the drawings, is not permitted.
- C. Reinforcing steel, before being positioned and just prior to placing concrete, shall be free from loose mill and rust scale and from any coatings, which may destroy or reduce the bond. Clean reinforcing steel by sandblasting or wire brushing and remove mortar, oil, or dirt to remove materials, which may

reduce the bond.

- D. Do no straighten or rebend reinforcing steel in the field.
- E. Position reinforcing steel in accordance with the drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to provide the specified concrete coverage. Bars additional to those shown on the drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position, shall be provided by the Contractor at his own expense.
- F. Place reinforcement a minimum of 2-inches clear of any metal pipe or fittings.
- G. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.
- H. Roll wire mesh used for reinforcement flat before placing concrete. Support and tie wire mesh to prevent movement during concrete placement.
- I. Position dowels for masonry walls to occur at reinforced block cells.

### **3.15 SITE MIXED CONCRETE**

- A. Conform to ACI 304.

### **3.16 READY-MIXED CONCRETE**

- A. Conform to ASTM C94.

### **3.17 PLACING CONCRETE**

- A. Conform to ACI 304.

### **3.18 PUMPING CONCRETE**

- A. Conform to ACI 304.2R-71.

### **3.19 WEATHER REQUIREMENTS**

- A. Conform to ACI 305 for placing during hot weather.
- B. Conform to ACI 306 for placing during cold weather.

### **3.20 BONDING TO OLD CONCRETE**

- A. Coat the contact surfaces with epoxy bonding compound. The method of preparation and application of the bonding compound shall conform to the manufacturer's printed instructions and recommendations for specific application for this project.

### 3.21 BACKFILL AGAINST WALLS

- A. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.
- B. Do not backfill the walls of structures, which are laterally restrained or supported by, suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.
- C. Do not use heavy equipment to compact backfill within 5-feet of vault walls. Compact by hand or other means which will not impose significant loads on the walls.

### 3.22 CONCRETE FINISHES

- A. Complete concrete surfaces in accordance with the following schedule:

| Finish Designation | Area Applied  |
|--------------------|---|
| F-1                | Beams, columns, and exterior walls not exposed to view.                                       |
| F-3                | Beams, columns, and walls of structures exposed to view. Underside of formed floors or slabs. |
| F-4                | Exterior and interior surfaces to be coated.  |
| S-1                | Slabs and floors to be covered with concrete or grout.  |
| S-4                | Slabs and floors of structures exposed to view.   |
| E-1                | Exposed edges. EXCEPTION: edges normally covered with earth.                                  |
| E-2                | Top of walls, beams, and similar unformed surfaces.   |

- B. Finish F-1. Repair defective concrete, fill depressions deeper than 1/2-inch, and fill tie holes.
  1. Finish F-3. In addition to Finish F-1, remove fins, fill depressions 1/4-inch or deeper, fill depressions and air holes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and 1 1/2 parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
  2. Finish F-4. Repair defective concrete, remove fins, fill depressions 1/16-inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16-inch.
  3. Finish S-1. Screed to grade without special finish.
  4. Finish S-4. Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

5. Finish E-1. Provide chamfer or beveled edges.
6. Finish E-2. Strike smoothly and float to an F-3 or F-4 finish.

### 3.23 CURING CONCRETE

- A. Conform to ACI 308.
- B. Water cure with burlap mats unless optional curing methods are permitted.
- C. Do not use curing compound on surfaces, which are to be coated in accordance with Section 09820 and 09900.
- D. It is the responsibility of the Contractor to select the appropriate curing method in response to climatical and/or site conditions occurring at the time of concrete placement. Take appropriate measures as described in ACI 305 and 306 for protecting and curing concrete during hot and cold weather.

### 3.24 REPAIR OF DEFECTS

- A. Do not repair defects until concrete has been reviewed by the Construction Manager.
- B. Surface Defects. Repair surface defects, which are smaller than 1-foot across in any direction and are less than 1/2-inch in depth.

Repair by removing the honeycombed and other defective concrete down to sound concrete, make the edges perpendicular to the surface and at least 3/8-inch deep, thoroughly dampen the surface, work into the surface a bonding grout (one part cement to one part fine sand), fill the hole with mortar, match the finish on the adjacent concrete, and cure as specified.

- C. Severe Defects. Repair severe defects which are larger than surface defects but do not appear to affect the structural integrity of the structure.

Repair by removing the honeycombed and other defective concrete down the sound concrete, make the edges of the hole perpendicular to the surface, sandblast the surface, coat the sandblasted surface with epoxy bonding compound, place nonshrink grout, match the finish on the adjacent concrete, and cure as specified.

- D. Major Defects. If the defects are serious or affect the structural integrity of the structure or if patching does not satisfactorily restore the quality and appearance to the surface, the Construction Manager may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section.

### 3.25 REPAIR OF CRACKS

- A. Repair cracks in structures which are wider than 1/10-inch in width by cutting out a square edged and uniformly aligned joint 3/8-inch wide by 3/4-inch deep, preparing exposed surfaces of the joint, priming the joint, and applying polyurethane joint sealant.
- B. If the cracks are serious or affect the structural integrity or function of the element, the Owner's Representative may require the concrete to be removed and replaced, complete, in accordance with the provisions of this section.

### **3.26 CONCRETE SURFACES TO BE COATED**

- A. See Sections 09820 and 09900.

### **3.27 ALUMINUM SURFACES IN CONTACT WITH CONCRETE**

- A. See Section 09900

### **3.28 RIGID INSULATION**

- A. Install the insulation on the vault wall, roof slab, and access hatch with lemon-sized gobs of compatible adhesive or with non-corroding washers. Space the attachments on 22-inch centers in both directions. Fasteners on 24-inch centers in the joints are acceptable if they have 2-inch washers. Run the insulation to the line shown on the plans. Keep all joints and abutments tight. Do not apply adhesive to insulation, which will deleteriously affect it in any way.
- B. Follow manufacturer's instructions on storing and handling the insulation.
  - 1. Shield the insulation with an opaque, light-colored tarp if it will be store in direct sunlight.
  - 2. Protect insulation from open flames and from heat sources over 165 degrees F.
  - 3. Avoid contact with petroleum-based solvents or with molten asphalt or tar.

\*\*\* END OF SECTION \*\*\*

## SECTION 03200

### REINFORCEMENT STEEL

#### PART 1 -- GENERAL

##### 1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish, fabricate, and place all concrete reinforcement steel, couplers, and concrete inserts for use in reinforced concrete and masonry construction and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories, all in accordance with the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Contractor Submittals
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 03100 - Concrete Formwork
- D. Section 04232 - Reinforced Concrete Block Masonry
- E. Section 03400 - Precast Concrete

##### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes:
- 1. The Building Code, as referenced herein, shall be the Uniform Building Code (UBC), as specified in section entitled, "Reference Standards." 01090
- B. Commercial Standards
- |               |   |
|---------------|---|
| ACI 315-80    | Details and Detailing of Concrete Reinforcement.  |
| ACI 318-77    | Building Code Requirements for Reinforced Concrete.<br>WRI Manual of Standard Practice for Welded Wire Fabric |
| AWS D1.4-79   | Structural Welding Code - Reinforcing Steel.  |
| ASTM A 82-79  | Specification for Steel Wire, Plain, for Concrete Reinforcement.  |
| ASTM A 185-79 | Specification for Welded Steel Wire Fabric for Concrete Reinforcement.  |
| ASTM A 615-82 | Specification for Deformed and Plain Billet-Steel Bards for Concrete Reinforcement.                           |

##### 1.04 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication in accordance with the requirements of section entitled, "Contractor Submittals." 01300
- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by the CONTRACTOR at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall shown the actual

lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams, which clearly indicate the dimensions of each bar splice.

- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the CONTRACTOR shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which shown the location of each coupler with details of how they are to be installed in the formwork.
- D. If reinforced steel is spliced by welding at any location, the CONTRACTOR shall submit mill test reports, which shall contain the information necessary for the determination of the carbon equivalent as specified in AWS D1.4. The CONTRACTOR shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding, merely a statement that AWS procedures will be followed is not acceptable.

### **1.05 QUALITY ASSURANCE**

- A. If requested by the ENGINEER, the CONTRACTOR shall provide samples from each heat of reinforcement steel delivered in a quantity adequate for testing. The OWNER will pay costs of initial tests. The CONTRACTOR shall pay costs of additional tests due to material failing initial tests.
- B. If reinforcement steel is spliced by welding at any location, the CONTRACTOR shall submit certifications of procedure qualifications for each welding procedure used and certification of welder qualifications, for each welding procedure, and for each welder performing the work. Such qualifications shall be as specified in AWS D1.4.
- C. If requested by the ENGINEER, the CONTRACTOR shall provide samples of each type of welded splice used in the work in a quantity and of dimensions adequate for testing. At the discretion of the ENGINEER, radiographic testing of direct butt-welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld, which fails to meet the requirements of AWS D1.4. The OWNER will pay the costs of testing; except, the CONTRACTOR shall pay the cost of all tests, which fail to meet specified requirements.

## **PART 2 -- PRODUCTS**

### **2.01 REINFORCEMENT STEEL**

- A. All reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
  - 1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise shown on the drawings.
  - 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 and the details shown; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter not less than 10-inches; and

provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

**B. Accessories:**

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Slab bolsters shall have gray plastic-coated legs.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Where the concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.

## **2.02 MECHANICAL COUPLERS**

- A. Mechanical couplers shall be provided where shown and where approved by the ENGINEER. The couplers shall develop a tensile strength, which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection.
- D. Couplers, which are located at a joint face, shall be a type, which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement past from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs, which have an O-ring seal.
- E. Hot-forged sleeve type couplers shall not be used.

## **2.03 WELDED SPLICES**

- A. Welded splices shall be provided where shown and where approved by the ENGINEER. All welded splices of reinforcement steel shall develop a tensile strength, which exceeds 125 percent of the yield strength of the reinforcement bars, which are connected.
- B. All materials required to perform the welded splices to the requirements of AWS D1.4 shall be provided.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements specified herein.

### **3.02 FURNISHINGS**

- A. All reinforcing steel shall be furnished, fabricated, and installed by the CONTRACTOR. The CONTRACTOR shall also furnish all the wires, metal supports, clips, spacers, and other appurtenances necessary to fulfill the requirements of the Contract Documents.
- B. Welded wire fabric, where required, shall be furnished as specified herein and where placed over the ground and shall be supported on wired concrete spacers or block supports spaced not more than 3-feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

### **3.03 FABRICATION**

- A. **General:** Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2 inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2 inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness, except for bars larger than 1-inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
- B. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the CONTRACTOR as specified under Section entitled "Contractor Submittals." 01300
- C. **Fabricating Tolerances:** Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:
  - 1. Sheared length:  $\pm$  1-inch
  - 2. Depth of truss bars: +0, - 1/2-inch
  - 3. Stirrups, ties, and spirals:  $\pm$  1/2-inch
  - 4. All other bends:  $\pm$  1-inch

### **3.04 PLACING**

- A. **Placing:** Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without

settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties, which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

- B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Bars additional to those shown which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.
- E. Placing Tolerances: Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the ENGINEER.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs as specified in Paragraph B herein. Slab bolsters shall be spaced not less than 30-inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane shown.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3-feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

### 3.05 SPACING OF BARS

- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall not be less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall not be less than one inch.
- C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.
- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

### 3.06 SPLICING

- A. **General:** Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the ENGINEER.
- B. **Splices of Reinforcement:** The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318, Section 12.15.1 for a class C splice.
- C. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- D. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.
- E. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner, which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the ENGINEER.

### 3.07 CLEANING AND PROTECTION

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

\*\*\* END OF SECTION \*\*\*

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The CONTRACTOR shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, all in accordance with the requirements of the Contract Documents.
- B. The following types of concrete shall be covered in this Section:
1. Structural Concrete: Concrete to be used in all cases except where noted otherwise in the Contract Documents.
  2. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, fence and guard post embedment, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise shown.
  3. Lean Concrete: Concrete to be used for thrust blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the Drawings as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 01300 - Contractor Submittals  
B. Section 03100 - Concrete Formwork  
C. Section 03200 - Reinforcement Steel  
D. Section 03290 - Joints in Concrete  
E. Section 03315 - Grout  
F. Section 03480 - Precast Concrete Specialties  
G. Section 07920 - Sealants and Caulking  
H. Section 16050 - Electrical General Provisions

##### **1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section; provided, that for Building Codes, the latest edition of the Code, as adopted as of the date of award by the agency having jurisdiction, shall apply to the WORK.
1. Codes and Standards: The Building Code, as referenced herein, shall be the Uniform Building Code (UBC), of the International Conference of Building Officials (ICBO). 01090
  2. Federal Specifications: UU-B-790A (Int. Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).
  3. Commercial Standards:

|               |   |
|---------------|---|
| ACI 214-77    | Recommended Practice for Evaluation of Strength Test Results of Concrete.   |
| ACI 301-79    | Specifications for Structural Concrete for Buildings.   |
| ACI 315-80    | Details and Detailing of Concrete Reinforcement.  |
| ACI 347-78    | Recommended Practice for Concrete Formwork.   |
| ASTM C156-80a | Test Method for Water Retention by Concrete Curing Materials.   |
| ASTM C31-84   | Methods of Making and Curing Concrete Test Specimens in the Field.  |
| ASTM C33-84   | Specification for Concrete Aggregates.  |
| ASTM C39-83b  | Test Method for Compressive Strength of Cylindrical Concrete Specimens.   |
| ASTM C94-83   | Specification for Ready-Mixed Concrete.   |
| ASTM C114-83b | Method for Chemical Analysis of Hydraulic Cement.   |
| ASTM C136-84a | Method for Sieve Analysis of Fine and Coarse Aggregate.   |
| ASTM C143-78  | Test Method for Slump of Portland Cement Concrete.  |
| ASTM C150-84  | Specification for Portland Cement.  |
| ASTM C157-80  | Test Method for Length Change of hardened Cement Mortar and Concrete.   |
| ASTM C192-81  | Method of Making and Curing Concrete Test Specimens in the Laboratory.  |
| ASTM C260-77  | Specification for Air-Entraining Admixtures for Concrete.   |
| ASTM C311-85  | Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.                            |
| ASTM C494-82  | Specification for Chemical Admixtures for Concrete.   |
| ASTM C618-85  | Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.                          |
| ASTM D1751-83 | Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). |
| ASTM E119-83  | Method for Fire Tests of Building Construction and Materials.   |

#### 1.04 CONTRACTOR SUBMITTALS

- A. Mix Designs: Prior to beginning the WORK, the CONTRACTOR shall submit to the ENGINEER, for review, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete specified herein in accordance with the Section entitled "Contractor Submittals." 01300 The mix designs shall be designed by an independent testing laboratory acceptable to the ENGINEER. All costs related to such mix design shall be borne by the CONTRACTOR.
- B. Certified Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall provide certified weighmaster delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the public weighmaster's signature, and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.
- C. When a water reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for

concrete both with and without the admixture.

- D. The CONTRACTOR shall furnish a Certificate of Compliance signed by the supplier identifying the type of fly ash and stating that the fly ash complies with ASTM C 618 and these Specifications, together with all supporting test data prior to the use of the fly ash the sample represents. The supporting data shall also contain test results confirming that the fly ash in combination with the cement and water to be used meets all strength requirements and is compatible with air-entraining agents and other admixtures.
- E. The CONTRACTOR shall submit to the ENGINEER for review the design mix for fly ash concrete together with the design mix for portland cement (non-fly ash) concrete as specified in this Section.

### **1.05 QUALITY ASSURANCE**

- A. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
- B. The cost of all laboratory tests on cement, aggregates, and concrete, will be borne by the OWNER. However, the CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications.
- C. Concrete for testing shall be supplied by the CONTRACTOR at no cost to the OWNER and the CONTRACTOR shall provide assistance to the ENGINEER in obtaining samples, and disposal and cleanup of excess material.
- D. Field Compression Tests:
  - 1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the ENGINEER to insure continued compliance with these specifications. Each set of test specimens will be a minimum of 4 cylinders.
  - 2. Compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
  - 3. Compression tests shall be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinder will be held to verify test results, if needed.
- E. Evaluation and Acceptance of Concrete
  - 1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 4 "Concrete Quality," and as specified herein.
  - 2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi.
  - 3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
  - 4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any 3 consecutive tests being below the specified compressive strength is 1 in 100. The required

average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.

5. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the CONTRACTOR.

F. Shrinkage Tests:

1. Drying shrinkage tests will be made by the ENGINEER for the trial batch specified in Paragraph 2.07, herein, and during construction to insure continued compliance with these Specifications.
2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: Specimens shall be removed from molds at an age of 23 ±1 hours after trial batching, shall be placed immediately in water at 70 degrees F ±3 degrees F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F ±3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F ±3 degrees F and 50 percent ±4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
3. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Paragraph 2.08, herein.

G. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 347.

H. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

| ITEM   | TOLERANCE  |
|--|--|
| Variation of the constructed linear outline from the | In 10-feet: 1/4-inch,<br>In 20-feet or more: 1/2 -inch |

|   |  |
|---|--|
| established position in plan                                      |  |
| Variation from the level or from the grades shown on the drawings | In 10-feet: ¼-inch,<br>In 20-feet or more: ½-inch  |
| Variation from the plumb  | In 10-feet: ¼-inch<br>In 20-feet or more: 1/2-inch |
| Variation in the thickness of slabs and walls                     | Minus ¼-inch; plus ½-inch                          |
| Variations in the locations and sizes of slab and wall openings   | Plus or minus ¼-inch                               |

- I. For each class of fly ash, all testing and sampling procedures shall conform with these Specifications and ASTM C 311, including the restriction that one sample weighing 4 pounds shall be taken from at least each 200 tons of fly ash supplied.
- J. Separate storage facilities shall be provided for fly ash. Fly ash shall be stored in such a manner as to permit ready access for the purpose of inspection and sampling and suitably protected against contamination or moisture. Should any fly ash show evidence of contamination or moisture or be otherwise unsuitable, the ENGINEER may reject it and require that it be removed from the site. Each class of fly ash used in concrete for this project shall be from the same source.

**PART 2 -- PRODUCTS**

**2.01 CONCRETE MATERIALS**

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.
- D. Materials for concrete shall conform to the following requirements:
  - 1. Cement shall be standard brand portland cement conforming to ASTM C 150 for Type V. Portland cement shall contain not more than 0.60 percent alkalis. The term "alkalies" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ( $Na_2O + 0.658 K_2O$ ). These oxides shall be determined in accordance with ASTM C 114. A single brand of cement shall be used throughout the work, and prior to its use, the brand shall be acceptable to the ENGINEER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the ENGINEER if requested regarding compliance with these Specifications.
  - 2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter,

alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/1 TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified in Paragraph 2.05B. Lightweight sand for fine aggregate will not be permitted.
  - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See Paragraph 2.07A for the use of the size groups.
  - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable.
  - c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
  - d. When tested in accordance with "Potential Reactivity of Aggregates (Chemical Method)" (ASTM C289), the ration of silica released to reduction in alkalinity shall not exceed 1.0.
  - e. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
  - f. When tested in accordance with "Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine" (ASTM C131), the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
  - g. When tested in accordance with "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (ASTM C88), the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.
4. Ready-mix concrete shall conform to the requirements of ASTM C94.
5. Air-entraining agent meeting the requirements of ASTM C 260 shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent; provided that, when the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one day, the total air content provided shall be 5 to 7 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent received on the job by the CONTRACTOR. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
6. Admixtures: Admixtures shall be required at the Engineer's discretion or, if not required, may be added at the Contractor's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the Contractor's expense. The use of an admixture shall e subject to acceptance by the ENGINEER. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.
  - a. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F,

a set retarding admixture such as Sika Chemical Corporation's Plastiment, Master Builder's Pozzoloth 300R, or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a set accelerating admixture such as Sika Chemical Corporation's Plastocrete 161 FL, Master Builder's Pozzoloth 50C, or equal shall be used.

- b. Low range water reducer shall conform to ASTM C 494, Type A. It shall be either a hydroxylated carboxylic acid type or a hydroxylated polymer type. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
- c. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G.

If the high range water reducing agent is added to the concrete at the batch plant, it shall be second generation type, Daracem 100, as manufactured by W.R. Grace & Co.; Pozzoloth 430R, as manufactured by Masterbuilders; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.

If the high range water reducer is added to the concrete at the job site, it shall be used in conjunction with a low range water reducer and shall be Pozzoloth 400N and Pozzoloth MBI.82, as manufactured by Masterbuilders; WRDA 19 and WRDA 79, as manufactured by W.R. Grace & Co.; or equal. Concrete shall have a slump of 3 inches  $\pm$  1/2-inch prior to adding the high range water-reducing admixture at the job site. The high range water-reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.

Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

7. Calcium Chloride: Except as otherwise provided in Paragraph 3.08B, calcium chloride will not be permitted to be used in concrete.
8. Fly ash/pozzolan shall conform to ASTM C 618, including the requirements of Table 1A, therein, and the following supplementary requirements:
  - a. Class C fly ash
    - Loss on ignition, maximum 1 percent
    - S03 content, maximum 4 percent
    - Moisture content, maximum 1 percent
    - $R = (CaO - 5\%)/(Fe2O3)$ , maximum 4.5
  - b. Class F fly ash
    - Loss on ignition, maximum 1 percent
    - S03 content, maximum 3 percent
    - Moisture content, maximum 1 percent
    - $R = (CaO - 5\%)/(Fe2O3)$ , maximum 1.5

## 2.02 CURING MATERIALS

A. Materials for curing concrete as specified herein shall conform to the following requirements:

1. Concrete curing compound shall be MB 429 as manufactured by Masterbuilders, Cleveland, OH; Hunt Process Clear ARB as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.
2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface.
3. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (Int. Amd. 1). The loss of moisture, when determined in accordance with the requirements of ASTM C-156, shall not exceed 0.055 gram per square centimeter of surface.
4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
5. Curing mats for use in Curing Method 6 as specified in Paragraph 3.09G herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
6. Evaporation retardant shall be used after initial screeding and floating when temperature, wind, and humidity condition may cause drying shrinkage cracks in slab and shall be a material such as Confilm as manufactured by Masterbuilders, Cleveland, OH; or equal.

### **2.03 NON-WATERSTOP JOINT MATERIALS**

- A. Materials for non-water stop joints in concrete shall conform to the following requirements:
  1. Preformed joint filler shall be a non-extruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
  2. Elastomeric joint sealer shall conform to the requirements of Section entitled "Sealants and Caulking." 07920
  3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the ENGINEER.

### **2.04 MISCELLANEOUS MATERIALS**

- A. Floor sealer/hardener shall be a colorless, aqueous solution of zinc and/or magnesium fluosilicate or of sodium silicate, and shall be as manufactured by Master Builders Company, W.R. Grace Co., or equal. The solution shall be delivered ready for use in the manufacturer's original sealed containers. Each gallon of the fluosilicate solution shall contain not less than 2 pounds of crystals.

- B. Damp-proofing agent shall be an asphalt emulsion, such as Sonneborn Hydrocide 660, Flintkote C-13-E Foundation Coating, or equal.
- C. Epoxy adhesives shall be the following products for the applications specified:
1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur Hi-Mod Epoxy Adhesive, as manufactured by Sika Chemical Corporation; Concesive 1001-LPL, as manufactured by Adhesive Engineering Company; or equal.
  2. For bonding hardened concrete or masonry to steel, Colma-Dur Gel, Sikadur Hi-Mod Gel, or equal.

## 2.05 CONCRETE DESIGN REQUIREMENTS

- A. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix designs with more than 41 percent of sand of the total weight of fine and coarse aggregate shall not be used. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. All changes shall be subject to review by the ENGINEER.
- B. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

| TYPE OF WORK   | MIN. 28-DAY<br>COMPRESSIVE<br>STRENGTH<br>(psi) | MAX. SIZE<br>AGGREGATE<br>(in.) | MIN.<br>CEMENT<br>PER<br>CU.YD.<br>(sacks) | MAX.<br>W/C<br>RATIO<br>(hy.wt.) |
|--|---|---------------------------------|--|----------------------------------|
| <u>Structural Concrete:</u><br>Walls, slabs on grade and<br>footing and all other<br>concrete items not<br>specified elsewhere | 4,000   | 1-1/2                           | 6.0  | 0.50                             |
| <u>Structural Concrete:</u><br>Roof, floor slabs,  | 4,000   | 1                               | 6.0  | 0.50                             |

|   |       |   |     |      |
|---|-------|---|-----|------|
| columns, sections 10-in. and less in thickness, and sections which require special placement due to shape or density of reinforcing or embedded items |       |   |     |      |
| Sitework Concrete   | 3,000 | 1 | 5.0 | 0.50 |
| Lean Concrete   | 2,000 | 1 | 4.0 | 0.60 |

\*Note: One sack of cement equals 94 lbs.

- C. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the CONTRACTOR shall be entitled to no additional compensation because of such changes.
- D. At the Contractor's option, fly ash/pozzolan may be used as a partial cement replacement in concrete as follows:
1. Fly ash shall replace not more than 15 percent by weight of the portland cement in the design mix. The design mix shall contain a minimum of 6 sacks of cement per cubic yard before the replacement is made.
  2. Fly ash for hydraulic/liquid containing structures shall be Class C fly ash. Fly ash concrete for all other structures shall be Class C or F fly ash.

## 2.06 CONSISTENCY

- A. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature of moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

| PART OF WORK                        | SLUMP (in.)                   |
|-------------------------------------|-------------------------------|
| Footings and slabs                  | 3-inches +1/2-inches, -1-inch |
| Other work                          | 3 inches ±1 inch              |
| With high range water reducer added | 8-inches max.                 |

## 2.07 TRIAL BATCH AND LABORATORY TESTS

- A. Before placing any concrete, a testing laboratory designated by the ENGINEER shall prepare a trial batch of each class of concrete having a 28-day strength of 4,000 psi or higher, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the properties in Paragraph 2.05A. If one size range produces an acceptable mix, a second

size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the CONTRACTOR. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process.

The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and 6 compression test specimens from each batch. The cost of not more than 3 laboratory trial batch tests for each specified concrete strength will be borne by the OWNER but the CONTRACTOR shall furnish and deliver the materials in steel drums at no cost. Any additional trial batch testing required shall be performed at the expense of the CONTRACTOR.

- B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
- C. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.

## **2.08 SHRINKAGE LIMITATION**

- A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age (as specified in Paragraph 2.07), shall be 0.036 percent or 0.043 percent, respectively. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch shrinkage requirements.
- B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirements by more than 25 percent.
- C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions, at no additional cost to the OWNER, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content, washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

## **2.09 MEASUREMENT OF CEMENT AND AGGREGATE**

- A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER; provided that, where batches are so proportioned as to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

## **2.10 MEASUREMENT OF WATER**

- A. The quantity of water entering the mixer shall be measured by a suitable water meter or other

measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete, and the meter shall include a set-back register with a readily visible vertical face and double hands indicating in cubic feet and decimals thereof. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

## **2.11 READY-MIXED CONCRETE**

- A. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the supplementary requirements specified in Paragraphs 2.12B through 2.11F, herein.
- B. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within 75 minutes after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In hot weather, or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 60 minutes.
- C. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a certified weighmaster delivery ticket furnished to the ENGINEER in accordance with Paragraph 1.04B, herein.
- G. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted.

Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

### **PART 3 -- EXECUTION**

#### **3.01 PROPORTIONING AND MIXING**

- A. **Proportioning:** Proportioning of the concrete mix shall conform to the requirements of Chapter 3 (Proportioning" of ACI 301; provided, that the maximum slump for any concrete shall not exceed 4 inches except when the use of high range water reducer is permitted which increases the maximum slump to 8 inches.
- B. **Mixing:** Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.
- C. **Slump:** Maximum slumps shall be as specified in Paragraph 2.06A, herein.
- D. **Retempering:** Retempering of concrete or mortar which has partially hardened will not be permitted.

#### **3.02 PREPARATION OF SURFACES FOR CONCRETING**

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.
- B. **Joints in Concrete:** Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the ENGINEER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. After the surfaces have been prepared all approximately horizontal construction joints shall be covered with a layer of mortar approximately one-inch thick. The mortar shall have the same proportions of cement and sand as the regular concrete mixture. The water-cement ration of the mortar in place shall not exceed that of the concrete to be placed upon it, and the consistency of the mortar shall be suitable for placing and working in the manner hereinafter specified. The mortar shall be spread uniformly and shall be worked thoroughly into all irregularities of the surface. Wire brooms shall be used where possible to scrub the mortar into the surface. Concrete shall be placed immediately upon the fresh mortar. When casting deep walls (more than 6-feet high) over slabs or footings, in lieu of the one-inch thick mortar, a 6-inch lift of a rich pea gravel mix with the same water-cement ration as the wall concrete shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.

- D. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the ENGINEER.
- E. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- F. All inserts or other embedded items shall conform to the requirements herein.
- G. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- H. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand-blasting (exposing aggregate) prior to the application of an epoxy bonding agent.
- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.
- J. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- K. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- L. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- M. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

### **3.03 HANDLING, TRANSPORTING, AND PLACING**

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section.
- B. Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the CONTRACTOR.
- C. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER in writing of at least 24 hours in advance of placement of any concrete.
- D. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.
- E. Casting New Concrete Against Old: An epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations. This provision shall not apply to joints where water stop is installed, see Section entitled, "Water stop Joints in concrete." 03290
- F. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- G. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

- H. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.
- I. Cold Weather Placement: Earth foundations shall be free from frost or ice when concrete is placed upon or against them. Fly ash concrete shall not be placed when the air temperature falls below 50 degrees F.

### **3.04 PUMPING OF CONCRETE**

- A. General: If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment: The pumping equipment must have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be 4 inches.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete will not be permitted.
- F. Proportioning: Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified in Paragraph 2.05, herein.
- G. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.
- H. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
- I. Water and slump requirements shall conform to Paragraphs 2.01D.2 and 2.05B for water and 2.06A for slump.
- J. Cement and admixtures shall conform to Paragraph 2.01D, herein.

- K. Field Control: Concrete samples for slump per ASTM C 143 and test cylinders per ASTM C 31 and C 39 will be taken at the placement (discharge) end of the line.

### **3.05 ORDER OF PLACING CONCRETE**

- A. The order of placing concrete in all parts of the work shall be acceptable to the ENGINEER. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4 of an inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2 of an inch above the underside of the strip. About one hour after the concrete is placed the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

### **3.06 TAMPING AND VIBRATING**

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high-speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Care shall be used in placing concrete around water stops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type water stops are placed horizontally, the concrete shall be worked under the water stops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the water stops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the water stops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

### **3.07 FINISHING CONCRETE SURFACES**

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from

plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Paragraphs 1.05G and 1.05H, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

- B. Formed Surfaces: No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as specified in Section 3.08 herein, and as shown on the exterior elevations.
  
- C. Unformed Surfaces: After proper and adequate vibration and tamping all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
  1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
  2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the ENGINEER.
  3. Finish U3 - After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
  4. Finish U4 - Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.

D. Unformed surfaces shall be finished according to the following schedule:

| UNFORMED SURFACE FINISH SCHEDULE   |        |
|--|--------|
| AREA   | FINISH |
| Grade slabs and foundations to be covered with concrete or fill material | U1     |
| Floors to be covered with grouted tile or topping grout                  | U2     |
| Slabs that are water bearing with slopes 10 percent and less             | U3     |
| Sloping slabs that are water bearing with slopes greater than 10 percent | U4     |
| Slabs not water bearing  | U4     |
| Slabs to be covered with built-up roofing                                | U2     |
| Interior slabs and floors to receive architectural finish                | U2     |

E. Floor Sealer Hardener (Surface Applied):

1. Floors to receive hardener shall be cured, cleaned, and dry with all work above the completed. Apply zinc and/or magnesium fluosilicate evenly using 3 coats, allowing 24 hours between coats.
2. The first coat shall be 1/3 strength, second coat 1/2 strength, and third coat 2/3 strength. Each coat shall be applied so as to remain wet on the concrete surface for 15 minutes. If sodium silicate is used, it shall be applied evenly, using 3 coats, allowing 24 hours between coats, and the material shall be applied full strength at the rate of one gallon per 300 square feet. Approved proprietary hardeners shall be applied in conformance with the manufacturer's instruction. After the final coat is completed and dry, surplus hardener shall be removed from the surface by scrubbing and mopping with water.
3. Floor hardener shall be applied where shown.

### 3.08 ARCHITECTURAL FINISH

- A. Smooth Concrete Finish: Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and all form-tie fastener holes filled as required in Paragraphs 3.12 and 3.13, herein.
- B. After the concrete has cured at least 14 days, the surface shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one part portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 1/2 gray and 1/2 white portland cement, as determined by the ENGINEER. White portland cement shall be Atlas white, or equal, furnished by the CONTRACTOR. Calcium chloride in the amount of 5 percent by volume of the cement shall be used in the brush coat. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all the surface grout has been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.
- C. Surface Overnight: Cleaning operations for any given day shall be terminated at panel joints. It is essential that the various operations be carefully timed to secure the desired effect, which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.
- D. In the event that improper manipulation results in an inferior finish, the CONTRACTOR shall rub such inferior areas with carborundum bricks.
- E. Before beginning any of the final treatment on exposed surfaces, the CONTRACTOR shall treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the ENGINEER and shall preserve said trial area undisturbed until the completion of the job.
- F. All architecturally treated concrete surfaces shall conform to the accepted sample in texture, color, and quality. It shall be the Contractor's responsibility to maintain and protect the concrete finish.

### 3.09 CURING AND DAMPPROOFING

- A. General: All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the work, and described in detail in the following paragraphs:

| SURFACE TO BE CURED OR DAMPPROOFED   | METHOD |
|--|--------|
| Unstripped forms   | 1      |
| Wall sections with forms removed   | 6      |
| Construction joints between footings and walls, and between floor slab and columns | 2      |
| Encasement concrete and thrust blocks  | 3      |
| All concrete surfaces not specifically provided for elsewhere in this paragraph    | 4      |
| Floor slabs on grade in hydraulic structures                                       | 5      |
| Roof and slabs not on grade  | 6      |
| Exterior buried surfaces of roof slabs   | 7      |

- B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 6, Paragraph 3.09G, herein.
- C. Method 2: The surface shall be covered with burlap mats, which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- E. Method 4: The surface shall be sprayed with a liquid curing compound.
1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film, which will seal thoroughly.
  2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
  3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
  4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied.

When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

- F. Method 5: Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each work operation as necessary to prevent drying shrinkage cracks.
1. Immediately after each square foot of the concrete has been finished, it shall be given a coat of curing compound in accordance with Method 4, Paragraph 3.09E, herein. Not less than one hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3 inches and fastened together with a waterproof cement to form a continuous watertight joint.
  2. The curing blankets shall be left in place during the 14-day curing period. A portion of the curing blankets may be temporarily removed for a maximum of 4 hours to allow placing of adjacent concrete work. The exposed slab shall be wetted with water delivered through a fog nozzle prior to placing the removed curing blankets back to the slab as specified in Section 3.09.F.1. Should the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.
- G. Method 6: Concrete slabs shall be treated with an evaporation retardant as specified in Method 5. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days beginning immediately after the concrete has been placed or forms removed. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes. Until the concrete surface is covered with the curing medium the entire surface shall be kept damp by applying water-using nozzles that atomize the flow so that the surface is not marred or washed. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed and curing compound immediately applied in accordance with Method 4, Paragraph 3.09E, herein. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the work.
- H. Method 7:
1. Method 6 shall be used for curing.
  2. Immediately after completion of curing the surface shall be sprayed with a damp proofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an

application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Damp proofing material shall conform to the requirements of Paragraph 2.04B, herein.

3. As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash.

### **3.10 PROTECTION**

- A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the OWNER. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring. Immediately following the first frost in the fall, the CONTRACTOR shall be prepared to protect all concrete against freezing. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one day, the concrete shall be maintained at a temperature not lower than 50 degrees F for at least 72 hours after it is placed.

### **3.11 CURING IN COLD WEATHER**

- A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at 50 degrees F.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive days, the specified 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

### **3.12 TREATMENT OF SURFACE DEFECTS**

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR at its own expense.
- B. Defective surfaces to be repaired as specified in Paragraph 3.12A, shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of Paragraph 3.08 or 3.09, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to filling any structure with water, all cracks that may have developed shall be "vee'd" as shown and filled with sealant conforming to the requirements of Section entitled "Joints in Concrete." 03290 This repair method shall be done on the water-bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

### **3.13 PATCHING HOLES IN CONCRETE**

#### **A. Patching Small Holes**

1. Holes that are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill material, shall be filled with non-shrink grout. Where a face of the member is exposed to view, the non-shrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall

then be patched according to Paragraph 3.12B herein.

3. Small holes through all other concrete members shall be filled with non-shrink grout, with exposed faces treated as above, or completely filled according to Paragraph 3.12B.

**B. Patching Large Holes**

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.
2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless shown.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have a bentonite type water stop material placed around the perimeter of the hole as specified in the Section entitled "Joints in Concrete," 03290 unless there is an existing water stop in place.

**3.14 CARE AND REPAIR OF CONCRETE**

- A. The CONTRACTOR shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the OWNER. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

\*\*\* END OF SECTION \*\*\*

## **SECTION 03480**

### **PRECAST CONCRETE SPECIALTIES**

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE OF WORK**

- A. The Contractor shall construct all manholes, catch basins, neutralization pits, cleanouts, and other appurtenances complete and in accordance with the Contract Documents.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 02200 – Earthwork
- B. Section 02617 – Reinforced Concrete Pipe
- C. Section 02630 - Ductile Iron Pipe
- D. Section 02655 - Vitriified Clay Pipe
- E. Section 02720 – Appurtenances
- F. Section 03305 – Minor Concrete

##### **1.03 REFERENCED SPECIFICATIONS, CODES AND STANDARDS**

- A. Without limiting the generality or other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the referenced standards; provided, that wherever the provisions of said publication are in conflict with the requirements specified here, the more stringent requirement shall apply.
- 1. Commercial Standards:
    - ASTM A478 – Specification for Precast Reinforced Concrete Manhole Sections

##### **1.04 CONTRACTOR SUBMITTALS**

- A. The Contractor shall submit drawings of precast concrete manhole sections showing details of reinforcement and joints in accordance with Section 01300 – Contractor Submittals.

#### **PART 2 -- PRODUCTS**

##### **2.01 PRECAST CONCRETE MANHOLE SECTIONS**

- A. Precast concrete sections, 600 mm and larger, in diameter, used as manhole sections shall conform to ASTM C478, Class IV, Wall C. Sections shall have rebate joints. Top sections shall be of the shape as indicated in the Contract Documents. Design and manufacture shall be based on H-20 loading. Precast manhole shall be equal in all respects to those manufactured by Associated Concrete Products, or centrifugally spun manhole units as manufactured by Ameron, or approved equal.

## **2.02 JOINT SEALANT**

- A. The joint sealant compound shall be Quik-seal, a pre-formed, cold-applied, ready-to-use plastic joint sealing compound as supplied by Quickset Utility Vaults, Santa Ana, California, Ram-Nek by K.T. Snyder Company, or approved equal.

## **2.03 NON-SHRINK GROUT**

- A. Grout, where required, shall be of the non-shrink type. The Contractor shall use non-shrink grout, which produces a void filling action that counteracts shrinkage occurring in both the plastic and hardening states. Grout shall be proportional with and in accordance with the manufacturer's instruction for the use intended.

## **2.04 MANHOLE STEPS**

- A. Manhole steps shall be ½-inch steel reinforced, plastic steps as manufactured by M.A. Industries, Inc.

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

- A. Precast concrete manhole sections shall be set so as to be vertical with sections and ladder rungs in true alignment. The joint of previously set section shall be covered with mortar and joint sealant before the new section is placed. Before the mortar is set, joints shall be pointed and exterior joints thoroughly tooled so as to be slightly concave with a hard polished surface free of cracks. Interior joints shall be tooled flush in a similar manner.
- B. Connections to manhole structure shall be made by casting sections of pipe into the base, by using non-shrink grout as indicated in the Contract Documents, and/or using an approved resilient connector.

### **3.02 CONCRETE CATCH BASINS**

- A. Concrete catch basins shall be of the type and sizes at the locations as indicated in the Contract Documents.

\*\*\* END OF SECTION \*\*\*

## SECTION 4201

### BRICK MASONRY

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE**

- A. The work of this Section includes the construction of [brick paved landscaped areas, brick wall,] and all appurtenant work, all in accordance with the requirements of the Contract Documents.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Concrete underbed for the brick paved areas shall conform to the applicable requirements of Section entitled, "Cast-in-Place Concrete." Reinforcing steel for the work specified herein shall conform to the applicable requirements of Section entitled, "Concrete and Masonry Reinforcement."

##### **1.03 REFERENCE SPECIFICATIONS AND STANDARDS**

- A. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the referenced documents to the extent that the provisions of such documents are not in conflict with the requirements of said code.
- B. Reference herein to "Building Code" shall mean the Uniform Building Code as defined under "Reference Standards and Specifications" in Section entitled, "General Requirements."

##### **1.04 CONTRACTOR SUBMITTALS**

- A. The Contractor shall submit 6 samples of brick to be used, showing true color and finish, for the approval of the Engineer as specified in Section entitled, "Contractor Submittals."

##### **1.05 QUALITY ASSURANCE**

- A. It is required that all masonry wall construction specified in this Section shall be subject to inspection and control by a Registered Construction Inspector licensed by the State of California as a Division III Specialty Inspector for Masonry, and no work hereunder shall be scheduled or performed without making prior arrangements to have said Registered Inspector present during all construction operations hereunder. [Both State Reg. & local Deputy]

##### **1.06 QUALITY ASSURANCE**

- A. It is required that all masonry wall construction specified in this Section shall be subject to inspection and control by a Registered Construction Inspector licensed by the State of Utah. No work hereunder shall be scheduled or performed without making prior arrangements to have said Special Inspector present during all construction operations hereunder. [Local Deputy Inspector only]

##### **1.07 QUALITY ASSURANCE**

- A. It is required that all masonry wall construction specified in this Section shall be subject to inspection and control by a person who is designated by the local public agency having jurisdiction as a Deputy Special Inspector for Masonry under the provisions of Section 305 of the Uniform Building Code, and no work hereunder shall be scheduled or performed without making prior arrangements to have said special inspector present during all construction operations hereunder.
- B. No special inspection will be required for construction of the brick paved landscape areas.

## **PART 2 -- PRODUCTS**

### **2.01 MASONRY MATERIALS**

- A. All brick paver materials shall conform to the following requirements.
1. Paving brick shall conform to the requirements of ASTM Designation C 62-69, Grade SW, Type 1 building brick. Size of brick shall be modular 3-3/8 inch by 3-inch by 11-3/8 inch. Overall dimensions shall not differ more than 1/8-inch from standard (nominal) dimensions. Paver brick shall be [Higgins "Flashed", brick in brown to red to tan range colors as selected by the Engineer, as manufactured by [Higgins Brick and Tile Company or an approved equal manufactured by Pacific Clay Products Company.] Color of mortar shall be [natural gray].
  2. Brick curb materials shall conform to the requirements of ASTM Designation C 216-71, Grade SW, Type FBX facing brick. Size of brick shall be modular 3-3/8 inch by 3-inch by 11-3/8 inch. Overall dimensions shall not differ more than 1/8-inch from standard (nominal) dimensions. Curb brick shall be [Higgins "Modular", size face brick in brown to red to tan range colors as selected by the Engineer, as manufactured by [Higgins Brick and Tile Company or approved equal manufactured by Pacific Clay Products Company]. Color of mortar shall be [natural gray].
  3. Brick Wall shall be burnt clay hollow masonry units conforming to ASTM Designation C 62-69. Brick units shall be ["Royale", 7-5/8 inch by 5-1/2 inch by 15-1/2 inch, with wire cut surfaces, as manufactured by Davidson Brick Company or an approved equal manufactured by Pacific Clay Products Company.] Color of brick shall be ["Standard Brick Red."] Color of mortar shall be [natural gray].
  4. Portland Cement shall conform to the requirements of ASTM Designation C 150-74, Type II, low alkali.
  5. Hydrated lime shall conform to the requirements of ASTM Designation C 207-74, Type S.
  6. Sand shall conform to the requirements of ASTM Designation C 144-70; except, that not less than 5 percent shall pass a No. 100 sieve.
  7. Water shall be clean and free of injurious amounts of deleterious substances.
  8. Vertical reinforcing steel for brick wall shall conform to requirements specified in Section entitled "Concrete and Masonry Reinforcement."
  9. Horizontal reinforcing steel for brick wall shall be 9 gauge steel wire in the form of a stirrup conforming to the requirements of ASTM Designation A 82-72.

## **PART 3 -- EXECUTION**

### **3.01 MORTAR**

- A. **Proportioning:** Mortar shall conform to the requirements of ASTM Designation C 270-73 and to the following requirements. Mortar shall be composed of one part white portland cement to not more than 1/4 part of hydrated lime. The volume of the damp, loose sand shall be not less than 2-1/2 times nor more than 3 times the sum of the volumes of the cement and limes used. Minimum strength shall be 2,000 psi at 28 days. The color of the mortar shall be as selected by the Engineer.
- B. **Mixing:** Mortar shall be mixed in a mechanically-operated mortar mixer for at least 3 minutes after all ingredients are in the drum, and at least long enough to make a thorough, complete, intimate mix of the materials.
- C. **Tempering:** The consistency of mortar shall be adjusted to the satisfaction of the mason, and water may be added as is necessary or convenient in using the mortar. This shall be done by forming a basin in the mortar, adding water and mixing it into the mortar mix, not by splashing water over the surface.

### **3.02 HANDLING AND STORAGE**

- A. All materials shall be delivered, stored, and handled in a manner to prevent damage by breakage, water or moisture, or the inclusion of foreign particles. No materials shall be dumped or stored on the ground. Materials shall be stored on a clean surface or platform as required and shall be protected from deterioration and foreign matter.

### **3.03 ENVIRONMENTAL CONDITIONS**

- A. Brick masonry work shall not be performed when the temperature is below 40 degrees F.

### **3.04 WETTING**

- A. All brick shall be wetted until they have an initial absorption rate not exceeding 0.25 ounce per square inch per minute as determined under the provisions of ASTM Designation C 67-73. When being laid, the brick shall have suction sufficient to hold the mortar and to delete the excess water from the mortar and grout. The brick shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed immediately after being laid, without destroying bond.

### **3.05 LAYING**

- A. All brick shall be clean and free of dust, dirt, or other foreign materials before laying.
- B. Before starting, brick paving pattern shall be laid out in both directions on full length boards, so that courses, bonding, jointing and termination of concrete borders will be pre-determined to result in a uniform installation. Approval of layout shall be obtained from the Engineer.
- C. Brick pavers and brick curb shall be laid in running bond pattern with struck joints as indicated on the drawings. Brick wall shall be running bond with toothed joints.

- D. All brickwork shall be plumb, level, and true to line, and all corners and angles shall be square unless otherwise indicated on the drawings.
- E. All courses shall be laid and worked out to properly coincide and align with adjacent work. No fractional parts of bricks will be permitted.
- F. All bed and joints shall be filled solid with mortar or grout. All mortar joints shall be straight, clean, and of uniform width of approximately 3/8-inch. All exposed joints shall be finished flush, struck flush or tooled as specified herein, before the mortar hardens.
- G. All unfinished brick paving shall be protected from rain water by using water-proof covering securely held in place. Brick paving shall be kept moist for a period of 3 days, by using a nozzle regulated to fog spray sufficient only to moisten the top surface but not of such quantity to cause water to soak through the paving.
- H. The brick wall shall be constructed in accordance with applicable requirements of the Building Code and as indicated on the drawings.

### **3.06 PROTECTION OF OTHER SURFACES**

- A. Brick paving including adjacent work of other trades affected by this work shall be properly protected from damage or staining during construction operations.

### **3.07 PATCHING**

- A. All holes or defective mortar joints in exposed work shall be pointed. Where necessary, defective joints shall be cut out and repointed.

### **3.08 SANDBLASTING**

- A. After brick has been laid and mortar has cured sufficiently, the brick shall be lightly sandblasted to produce desired affect approved by Engineer. A portion of each brick application, brick pavers, brick curb and brick wall shall be erected and sandblasted to become representative samples of the brick work and upon acceptance by the Engineer may become as part of the completed brick work. During sandblasting the Contractor shall protect adjacent materials as may be required.

### **3.09 CLEANING**

- A. Exposed work shall be protected against staining from grouting or other sources and excess mortar shall be cleaned off the surfaces as the work progresses.
- B. At the completion of the work, all exposed work shall be cleaned.
- C. If ordinary cleaning is not adequate, special methods such as sandblasting or chipping shall be used to clean the surfaces upon direction of the Engineer.

\*\*\* END OF SECTION \*\*\*

## SECTION 04220

### CONCRETE UNIT MASONRY

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE**

- A. This section covers concrete unit masonry materials and construction as shown on the drawings and as specified herein.
- B. All materials shall comply with the current edition of the Uniform Building Code as adopted by the City.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Cement and reinforcing steel shall conform to the requirements of Section 03301, General Concrete, and the requirements herein.

##### **1.03 REFERENCE DOCUMENTS**

- A. Commercial Specifications.
  - ASTM C90 Concrete Masonry Units
  - ASTM C144 Masonry Mortar
  - ASTM C207 Hydrated Lime
  - ASTM C404 Aggregate

##### **1.04 CLEAN UP**

- A. Cleaning. Extreme care shall be taken to keep all exposed block clean and free from mortar. All exposed block in addition shall be cleaned by light sandblasting.

#### **PART 2 -- PRODUCTS**

##### **2.01 MATERIALS**

- A. Concrete Block and Slump Block. Concrete masonry units shall conform to the requirements of ASTM C90, Grade N-1 and shall be of the type and size indicated. Slump block units shown on the drawings shall be slumped units as defined by the Concrete Masonry Association of California and Nevada and shall be colored as approved by Owner.
- B. Mortar shall be composed of one part Portland cement and not less than two and one-half parts nor more than three parts of sand, based on dry loose volumes and not less than one-fourth part and not more than one-half part lime putty or hydrated lime. Mortar shall be colored as approved by Owner.
- C. Grout shall consist of one part Portland cement to not more than three parts sand and not less than one part nor more than one part pea gravel based on dry loose volume. The combined mix shall be

proportioned to make a workable mix. Sufficient water shall be added to cause it to flow into all joints of the masonry. Grout shall develop a minimum compressive strength of 2,500 psi in 28 days.

- D. Mortar and Grout Materials. Cement shall conform to the requirements set forth for Portland cement in Section 03302, General Concrete.
- E. Sand for use in masonry mortar shall conform to ASTM C144.
- F. Hydrated lime for use in masonry mortar shall conform to ASTM C207.
- G. Aggregates for use in masonry grout shall conform to ASTM C404.
- H. An expanding, water-reducing, retarding high lift grouting aid as manufactured by Sika shall be added to grout in accordance with the manufacturer's recommendations.
- I. Block Sealer. Acrylic block sealer and clear acrylic block finish shall be specifically formulated for masonry and shall be as manufactured by Porter International, Koppers or Tnemec.

## **2.02 MEASUREMENTS**

- A. Materials for mortar and grout shall be accurately measured in suitably calibrated devices. Shovel measurements will not be acceptable. One sack of Portland cement (94 lbs.) shall be considered as one cubic foot. When sand is damp, allowance for bulking shall be made.

## **PART 3 -- EXECUTION**

### **3.01 MIXING MORTAR AND GROUT**

- A. One half the sand and water shall be placed in the operating mixers, after which the cement, lime and remainder of the sand and water shall then be placed into the mixer in order named. After all materials are in the mixer, mixing shall continue as long as required to secure uniform blending of the ingredients, but in no case for less than three minutes.
- B. Equipment for mixing and handling mortar and grout shall be acceptable to the Owner. Mixers of at least one-sack capacity shall be used. Batches requiring fractional sacks will not be permitted unless the cement is weighed for each such batch.
- C. Retempering of mortar shall be done only by adding water into a basin made with the mortar and the mortar carefully worked into it. Retempering by dashing water over the mortar shall not be permitted. Any mortar or grout which is unused within one hour after initial mixing shall be removed from the work. Mortar shall be mixed and maintained on the boards to a slump of 2-3/4" plus or minus 1/4" using a truncated cone 4" to 2", 6" high.

### **3.02 CONSTRUCTION**

- A. All cells and coarses containing reinforcement, or designated to be filled in the plane, shall be filled

with grout. Concrete masonry shall be built to maintain the unobstructed vertical continuity of the cells to be filled. The vertical alignment of cells to be filled shall provide a clear unobstructed vertical flue not less than 3" by 3". Maximum height of grout pour shall be 4 feet. Beams shall be filled in one pour. Grout shall be consolidated by rodding before initial set occurs.

- B. Reinforcing steel shall be in accordance with the subsection entitled "Reinforcing Steel" and shall be straight except as shown or required for placement, and shall be lapped 36 diameters at splices. Steel at splices shall be wired together or separated by one bar diameter. Horizontal reinforcing shall be laid in the webs of bond beam or channel block, and solidly grouted in place.
- C. Where grouting is stopped for one hour or longer, a horizontal construction joint shall be formed by stopping the grout pour one and one-half inches below the top of the filled blocks.

### **3.03 SEAL COATING**

- A. All interior and exterior wall surfaces of the building shall receive one coat of block sealer and one coat of clear finish in accordance to the manufacturer's recommendations.

\*\*\* END OF SECTION \*\*\*

## SECTION 11231

### FLAP GATES

#### **PART 1 -- GENERAL**

##### **1.01 SCOPE**

- A. The Contractor shall furnish and install flap gates in the locations shown, complete and operable, including frames, wall thimbles, bracing, mountings, sealant, coatings, etc. as specified herein, all in accordance with the requirements of the Contract Documents.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 11290 - Hydraulic Gates and Valves, General

#### **PART 2 -- PRODUCTS**

##### **2.01 FLAP GATES**

- A. Design: Flap gates and frames shall be of cast iron construction, shall have fully-adjustable, top pivot points, and shall be provided with bronze sealing surfaces. Gate frames shall have flat backs for attachment to wall thimbles. Flap gates shall open with a differential pressure of one foot of water or greater on the upstream side and shall shut and seal with a differential pressure of 6-inches of water column or greater.
- B. Sealant: The elastomeric sealant shall be Rubber Caulk Sealer as manufactured by Products Research Company, Los Angeles, or approved equal.
- C. Suppliers, or equal:
1. Hydro Gate Corp., Model 20C or 10C for round openings.
  2. Rodney Hunt Model No. FV-AC.

#### **PART 3 -- EXECUTION**

##### **3.01 INSTALLATION**

- A. Flap gates shall be installed in strict accordance with the manufacturer's printed recommendations and the requirements herein.
- B. Just prior to setting each gate, a 1/8-inch thick layer of mastic grade polysulfide elastomeric sealant shall be applied to the back of the gate frame. After setting the gate, the nuts shall be run down on the anchor bolts just far enough to make them snub and to cause the rubber sealant to begin to come out, but not far enough to produce any significant stress in the frame. Any excess sealant at the edges shall be removed. The sealant shall be allowed to cure for at least 7 days, after which the anchor bolt nut shall be tightened to their final positions.

\*\*\* END OF SECTION \*\*\*

**SECTION 11232**  
**SLIDE/STOP GATES**

**PART 1 -- GENERAL**

**1.01 SCOPE**

- A. The Contractor shall furnish and install slide/stop gates in locations shown, complete and operable, including manual and electric operators, bracing, frames, mountings, etc. as specified herein, all in accordance with the requirements of the Contract Documents.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 11290 - Hydraulic Gates and Valves, General  
B. Section 15101 - Valve Operators

**1.03 QUALITY ASSURANCE**

- A. The leakage allowance for slide gates shall not exceed 0.1 gpm per foot of seating perimeter under 20 foot of seating head, and 0.2 gpm per foot under 20 foot of unseating head.

**PART 2 -- PRODUCTS**

**2.01 MATERIALS**

- A. All plastic and fiberglass items shall be manufactured of material suitable for potable water and shall be certified for such use on the shop drawings. Bolts, anchor bolts, nuts, washers and supports shall be provided for all plastic and fiber glass items in accordance with the requirements of the manufacturers of the plastic and fiber glass items. All bolts, anchor bolts, washers and supports required in connection with the plastic or fiberglass items shall be of Type 316 stainless steel.
- B. All gates shall be new and of current manufacture, and adequately braced to prevent warpage and bending under the intended use. Where designated, gates shall be furnished with electric operators provided by the gate manufacturer. All operators of a given type shall be furnished by the same manufacturer.

**2.02 ALUMINUM SLIDE GATES**

- A. Aluminum slide gates shall be self-contained, hand crank-operated, with Type 316 or other approved stainless steel operating stems.
- B. Suppliers, or Equal:
1. Rodney Hunt;
  2. Hydro Gate Corp.;
  3. Washington Aluminum Company, Inc. (WACO).

### **2.03 FIBER GLASS STOP GATES**

- A. Stop gates shall be as shown and shall be of fiberglass, with fiberglass surface-mounted guide frames of a size to allow hand operation. Mounting hardware, if required, shall be of Type 316 stainless steel.

### **PART 3 -- EXECUTION**

#### **3.01 INSTALLATION**

- A. Slide/stop gates shall be installed in strict accordance with the manufacturer's printed recommendations and the requirements herein.

\*\*\* END OF SECTION \*\*\*