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# TECHNICAL SPECIFICATIONS

## SECTION 1

### TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC

#### PART 1 - GENERAL

##### 1.1 Scope

###### A. General

These Technical Specifications cover temporary protection and direction of traffic, including accommodations for public traffic and work zone traffic control. The Work includes, but is not limited to, preparing and following a traffic control plan; providing temporary traffic control measures; and furnishing, installing, and maintaining temporary traffic control devices.

###### B. Work Zone Traffic Control

1. This work consists of providing temporary traffic control measures (TCM) and furnishing, installing, moving, operating, maintaining, inspecting, and removing traffic control devices (TCD) throughout the Project area according to the Project Drawings and Specifications, the Oregon Standard Drawings, the traffic control plan (TCP) for the Project, or as described.
2. All traffic control devices such as temporary signing, barricades, barriers, guardrail, attenuators, pedestrian fencing, lights, cones, temporary pavement striping, etc., required to warn, protect, or direct the public during the life of the Contract shall be furnished, installed, moved, and removed by the Contractor. When conditions warrant their use, flaggers and/or pilot cars shall also be provided by the Contractor. The determination of what measures are required, in addition to those specifically called for by the Drawings and Specifications, shall be solely the responsibility of the Contractor.
3. The Engineer and Owner are not responsible for determining whether proper traffic control devices are being utilized. Should the Contractor fail to furnish, maintain, and replace the necessary traffic control devices, the Owner or Engineer may, but shall not be required to, bring to the Contractor's attention, by written notice, such failure, and the Contractor shall undertake such corrective measures as is proper.

##### 1.2 Abbreviations

ADT	Average Daily Traffic
ODOT	Oregon Department of Transportation
QPL	Qualified Products List (ODOT)

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TCD	Traffic Control Devices
TCM	Traffic Control Measures
TCP	Traffic Control Plan
TCS	Traffic Control Supervisor
TSS	Temporary Sign Support
PCMS	Portable Changeable Message Sign

#### 1.3 Definitions

- A. Oregon Standard Specifications for Construction

Oregon Department of Transportation Standard Specifications for Construction, current edition.

- B. Traffic Control Devices (TCD)

Signs, signals, markings, and other devices placed on or adjacent to a road to regulate, warn, or guide traffic.

- C. Traffic Control Measures (TCM)

Elements of the TCP including, but not limited to, TCD, personnel, materials, and equipment used to control traffic through a work zone.

- D. Traffic Control Plan (TCP)

A written and drawn plan for handling traffic on a specified roadway through a work zone.

- E. Work Zone

An area within roadway construction, maintenance, or utility work activities.

#### 1.4 Standards

Use and follow the current edition of the ODOT "Sign Policy and Guidelines for the State Highway System," the current edition of the "Manual on Uniform Traffic Control Devices (MUTCD)," these Specifications, and the Oregon Standard Drawings listed below in designing, applying, installing, maintaining, inspecting, and removing traffic control devices. Copies of Oregon Standard Drawings TM800, TM810, TM820, TM841, and TM850 are included at the end of this Section of the Technical Specifications.

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#### 1.5 Applicability

Items specified in this Technical Specification are intended to be broad in scope and may not always apply to all items of Work to be constructed. All applicable sections, as determined by the Engineer, shall control the Work outlined in the Contract Documents.

#### 1.6 Traffic Control Description

##### A. Traffic Control Plan

The Contractor shall prepare a written Traffic Control Plan and submit it to the Engineer a minimum five days before the pre-construction conference for review by the Engineer. The TCP shall show all Traffic Control Measures and all Traffic Control Devices. The Contractor shall describe the order and duration of TCM for all phases of the construction work.

##### B. Additional Requirements:

1. Follow Jackson County Supplemental Standard Specifications for traffic control
2. Provide for adjustments to the traffic control measures and devices for the various stages of the Contractor's Work.

### PART 2 - MATERIALS

#### 2.1 Traffic Control Devices

##### A. General

1. The Contractor shall use new or like-new TCD for all installations unless otherwise specified. All TCD shall conform to Section 00225 of the Oregon Standard Specifications for Construction, current edition. Provide test results and quality compliance certificates, equipment lists, and drawings when specified.
2. Acceptance will be based on the ODOT QPL, test results, quality compliance certificates, equipment lists, drawings, and testing as necessary to ensure compliance with the Specifications.

B. The Contractor shall use Category I, Category II, and Category III TCD conforming to the National Cooperative Highway Research Program (NCHRP) Report 350. Category I devices are low-mass devices including, but not limited to, conical markers, tubular markers, plastic drums, and delineators. Category II devices include, but are not limited

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to, barricades and sign supports. Category III devices include, but are not limited to, impact attenuators, end treatments, and concrete barriers.

- C. Temporary Signing
  - 1. The Contractor shall use new temporary signs and accessories. Use materials and fabricate signs conforming to Oregon Standard Specifications - Section 00940.
  - 2. Use standard size and shape signs conforming to the current edition of the MUTCD and "Sign Policy and Guidelines for the State Highway System" unless otherwise specified or ordered.
  - 3. Double-face signs will not be allowed except for flagger "STOP/SLOW" sign paddles.
  - 4. Use Type "00" signs unless otherwise indicated in this Section or in the TCP.
- D. Other TCD. Provide TCD as specified or as required for the work zone traffic control that may include:
  - 1. Temporary Sign Supports (TSS)
  - 2. Amber Flashers
  - 3. Sign Flag Boards
  - 4. Temporary Barricades
  - 5. Guardrail Barrier
  - 6. Concrete Barrier
  - 7. Impact Attenuators
  - 8. Barrier and Guardrail Mounted Reflectors
  - 9. Glare Shields
  - 10. Temporary Pedestrian Fencing
  - 11. Temporary Traffic Delineation
  - 12. Tubular Markers
  - 13. Conical Markers
  - 14. Surface Mounted Tubular Markers
  - 15. Plastic Drums
  - 16. Delineators
  - 17. Pavement Markers
  - 18. Reflective Pavement Markers
  - 19. Flexible Oiling Pavement Markers
  - 20. Flexible Overlay Pavement Markers
  - 21. Temporary Tape

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22. Striping
23. Temporary Illumination
24. Temporary Traffic Signals
25. Sequential Arrow Signs
26. Portable Changeable Message Signs
27. Temporary Illumination for Nighttime Flaggers
28. Pilot Cars

### PART 3 - EXECUTION

#### 3.1 Accommodations for Public Traffic

##### A. Scope

This work consists of maintaining facilities to accommodate public traffic through and within the Project area. Public traffic includes motor vehicles, bicycles, and pedestrians. The Contractor's responsibilities for accommodating public traffic begin on the day any on-site work begins within the Project limits. Provide for the safety and convenience of the public and:

1. Be responsible for damages to property, injury to persons, loss, expense, inconvenience, and delay caused by or resulting from any act, omission, or neglect of the Contractor, the Contractor's Subcontractors and Suppliers, or their employees while performing the Work.
2. Conduct Work at all times for the least possible interference with or hazard to the traveling public and residents affected by the Project.
3. Do not perform Work that would restrict or interrupt traffic movement on opposite sides of the traveled way at the same time.
4. Keep the existing lanes of traffic open and in operation through the Project at all times, except one lane may be closed to traffic in the immediate work area, but only during hours Work is actually being performed. All lanes may be closed to traffic on a limited basis when approved by the Owner.
5. Do not stop or hold vehicles or block driveways, intersections, or connections for more than 20 minutes unless otherwise authorized in writing.
6. Submit proposed methods and lane closure times in each instance to the Engineer for approval with ample time to allow the traveling public to be notified through the news media.

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7. Obtain the Engineer's approval before closing any lanes.
8. Do not close any lane until the area is signed according to the requirements of this Section.
9. Park construction equipment, vehicles, and stockpile material at least 30 feet from the traveled way. If this is not possible, protect the equipment, vehicles, and stockpiled material with barriers or other satisfactory means.
10. Provide and maintain in a safe condition temporary access to business and residence driveways, temporary intersections, and temporary connections with roads, streets, bikeways, sidewalks, and footpaths.
11. Provide protection from work areas.
12. Allow emergency vehicles immediate passage at all times.

#### B. General Requirements

Provide the following for public traffic in all construction areas:

##### 1. Traffic Nuisance Abatement

If loose rock or dust exists on roadway surfaces and shoulders, the Contractor shall do one or more of the following:

- a. Use pilot cars and/or flaggers.
- b. Apply a fine spray of water to the surface.
- c. Broom paved surfaces with power brooms.

##### 2. Detours and Stage Construction

Construct and remove, if required, detours, stage construction roadways, shoulders, and temporary bridges, including accessory features shown on the Drawings.

##### 3. Driveways

While working on subgrade and other construction, provide adequate access to businesses, residences, intersections, and connections as follows:



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- a. Replace and maintain temporary aggregate driveways, approaches, crossings, and intersections as needed.
- b. Use reasonably well-graded aggregate material.
- c. Before placing the permanent base, do one of the following:
  - 1) Uniformly spread the temporary aggregate material over the subgrade.
  - 2) Remove and place the temporary aggregate material in the shoulder slope area if it meets quality requirements.
  - 3) Dispose of the temporary aggregate material in a satisfactory manner.

#### 4. Adjacent to Excavations

Where paved shoulders adjacent to excavations are less than 4-feet wide, protect the traffic as follows:

- a. At the end of each working day, backfill pavement edge excavations to the elevation of the existing pavement with permanent base material or with a temporary wedge of aggregate as shown on the Drawings.
- b. Do not excavate along both edges of the pavement adjacent to traffic at the same time. Before excavating at the edge of the pavement on the opposite side of the roadway, complete the construction to existing pavement elevation on the side that was excavated first.
- c. Remove the temporary wedge of aggregate material, if used, before placing permanent base material, and place it in the shoulder slope area or spread it uniformly over the subgrade.

#### C. Surface Maintenance Responsibilities

Provide adequately maintained accommodations at all times for public traffic through and within the Project.

1. The Contractor shall be responsible for maintaining surfacings during construction at the Contractor's expense including the following:

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- a. Keeping surfaces being used by public traffic free of dirt, mud, or other harmful materials.
  - b. Repairing damage to surfaces caused by the Contractor's operations.
  - c. Maintaining any detour or stage construction surfacing not constructed as specified or directed.
2. The Owner will be responsible for the following during construction at Owner's expense:
- a. Maintaining surfacings and shoulders in existence at the start of the Project that have not been damaged by Contractor operations.
  - b. Maintaining surfaces of detours and intermediate stage construction during the time they are being used by public traffic, but only if constructed according to the Drawings or as directed.
  - c. Sanding icy pavements and removing the sand residue.
  - d. Removing snow from traveled ways as required to accommodate public traffic.
3. Work Suspensions

During work suspensions, the Contractor shall maintain surfacings for which the Contractor is responsible and shall maintain work zone traffic control.

- a. Suspensions Due to Fault of the Contractor.

If the suspension is due to any cause within the control or responsibility of the Contractor, including failure to perform any provisions of the Contract or correct conditions unsafe for the general public, workers, or Owner's employees, then the Contractor shall do the following:

- 1) Assume sole responsibility for making provisions for traffic acceptable to the Engineer.
- 2) Be solely responsible for the costs of maintaining surfaces under traffic, the Work, and work zone traffic control during the suspension.

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b. Suspensions Due to Other Causes

If the Work is suspended due to winter seasonal conditions or any cause not related to any fault or negligence of the Contractor, the Contractor shall:

- 1) Place uncompleted traveled ways, shoulders, driveways, approaches, connections, and detours necessary for traffic in a maintainable, acceptable condition.
- 2) Be responsible for the Work.
- 3) Be responsible for work zone traffic control.

The Owner will then assume responsibility for maintenance of the roadway surfaces during "Suspensions Due to Other Causes."

D. Opening Sections to Traffic

1. When it is in the public interest, the Owner may request any portion of the Work be opened to traffic. If the portion opened to traffic has been finished in an acceptable manner, it will be designated as "accepted for traffic," and the Contractor will be relieved of maintaining it for legal public traffic. If the portion of the Work to be opened to traffic has not been finished in an acceptable manner, it shall be maintained by the Contractor in a condition serviceable and adequate for traffic until it is finished in an acceptable manner except when the Work is suspended due to winter seasonal conditions or any cause not related to any fault or negligence of the Contractor.
2. The Owner may request the Contractor maintain portions of the Work designated "accepted for traffic" via a Change Order. The Contractor shall maintain portions of the Work open to traffic but not "accepted for traffic" at no additional compensation.
3. The "accepted for traffic" portion(s) of the Work will:
  - a. Be accepted only to the extent the Contractor is relieved of maintaining these portions for legal public traffic after acceptance.
  - b. Not entitle the Contractor to reduction of retainage.

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- c. Not relieve the Contractor's responsibility for damages to the Work from causes other than legal public traffic.
  - d. Not constitute a waiver of any provision of the Contract.
- 4. If the Contractor delays the completion of shoulders, drainage structure, or other features of the Work, the Owner may request all or any portion of the Work to be opened to traffic. In this case, the Contractor shall be responsible for maintenance during the period the Work is open to traffic until final acceptance. The Contractor shall conduct the remaining operations to cause the least obstruction to traffic and bear all additional costs caused by the presence of traffic.
- 5. In addition, no payment will be made for costs incurred by the Contractor because of:
  - a. Inconvenience,
  - b. Additional length of travel to conform to established traffic patterns and planned access features, or
  - c. Compliance with Laws and Regulations governing traffic and load limitations.
- 6. Costs anticipated because traffic will be using portions of the Work will be included in the Contract prices for the various items of Work involved.

#### 3.2 Work Zone Traffic Control

##### A. General Requirements

The Contractor shall be responsible to provide and maintain all TCM. The Engineer may verbally or in writing require immediate changes to the TCM being used on the Project. The Contractor shall immediately make these changes. The Contractor shall submit all proposed TCM revisions to the Engineer for review.

- 1. The Contractor shall not start Work on any stage of construction until the TCP has been reviewed, all TCM are in place, and the TCP is operating satisfactorily. During construction, the Contractor shall determine if additional TCD are required in addition to those in place and immediately notify the Engineer. The Contractor shall immediately make changes as required, but shall not place or remove devices without prior notice to the Engineer.

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2. After TCD have been accepted in place on the Project, the Contractor shall inspect and maintain the condition of the devices.
3. The Contractor shall immediately correct any unsafe conditions. TCM may be performed by the Owner if the Contractor fails to correct an unsafe condition. Costs for Work performed by the Owner will be deducted from monies due the Contractor. In any case, the Contractor has sole responsibility for public safety.
4. The Contractor shall provide TCM outside the Contract limits when required.
5. All electrical equipment, materials, and Work shall conform to National Electric Code requirements and any other Laws and Regulations that apply.

#### B. Routing Traffic Over Surfacing

When allowed by the TCP, control traffic being routed over newly constructed surfacings as follows:

##### 1. Aggregates

Control traffic over aggregate surfacings with flaggers or flaggers and pilot car(s).

##### 2. Asphalt Concrete

Control traffic over asphalt concrete shall be according to Technical Specifications - "Road Work."

##### 3. Oil Mats/Chip Seals

Control traffic over asphalt oil mats or chip seals with flaggers and pilot car(s) until the entire surface has been broomed or bladed after the aggregate is placed.

##### 4. Sand Seals

Control traffic with flaggers and pilot car(s) during application of asphalt and until the asphalt is covered with aggregate, unless otherwise directed.

#### C. Flaggers

1. Use flaggers, a Traffic Control Supervisor (TCS), signal operators, and pilot car operators who have:

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- a. The mental and physical ability to provide timely, clear, and positive guidance.
  - b. A sense of responsibility for safety of public and work crew.
  - c. A neat appearance.
  - d. A courteous but firm manner.
  - e. Completed an approved work zone traffic control and flagging course within the past three years and have in their possession a current, valid certificate verifying their training.
2. Equip flaggers as follows:
- a. Clothing to cover the complete body except head, neck, and arms below the point of the shoulders.
  - b. A retroreflective vest colored orange, yellow, strong yellow green, or a fluorescent version of these colors. The retroreflective material shall be orange, yellow, white, silver, strong yellow green, or a fluorescent version of one of these colors, and shall be visible at a minimum distance of 1,000 feet. The vest shall be designed to identify the wearer as a person and be visible through the full range of body motions.
  - c. A fluorescent yellow-green, orange, yellow, or bright white hard hat or baseball-style cap.
  - d. Hard hats to be worn when there is danger of falling or flying objects or electrical shock or burns.
  - e. Highly visible "STOP/SLOW" sign paddles conforming to the MUTCD and fabricated using encapsulated lens reflective sheeting or brighter.
  - f. Portable, self-contained two-way radio with a range suitable for the Project.
  - g. Illuminated stand area of high visibility at night.
- D. Traffic Control Supervisor

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1. The Contractor shall appoint a trained person on the Project Site during working hours and on call at all other times who:
  - a. Is responsible to maintain all TCD in proper position and condition.
  - b. Is equipped with a two-way radio with a range suitable for the Project.
  - c. Has the authority to assign and control flagging operations.
  - d. Files his/her name and telephone number with the Engineer and local police
2. The TCS shall personally perform all duties of the TCS.
3. The TCS shall have completed an approved work zone traffic control supervisor and flagging course within the past three years and have in their possession a current, valid certificate verifying their training as a TCS by an Oregon State TCS Certification Class Approved training course.
4. The Contractor shall equip the TCS as follows:
  - a. Clothing, vest, hard hat, or cap equivalent to that of flaggers.
  - b. A portable, self-contained two-way radio with a range suitable for the Project.
  - c. A cellular telephone that is active 24 hours a day.
  - d. A vehicle that is equipped with a roof or post mounted rotating amber light.

#### E. Construction

The Contractor shall install, inspect, move, operate, maintain, and remove temporary TCD according to the Drawings, these Specifications, and Sections 00225.40 through 00225.67 of the Oregon Standard Specifications for Construction.

#### PART 4 - MEASUREMENT AND PAYMENT

##### 4.1 Basis

See Technical Specifications - "Measurement and Payment" for a description of the basis of measurement and payment for Work performed under this Contract.

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**SECTION 1**  
**TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC**

END OF SECTION



TAPER	FORMULA
Merging (Lane Closure)	"L"
Shifting	"L"/2 or 1/2"L"
Shoulder Closure	"L"/3 or 1/2"L"
Flagging (See Dwg. TM850)	50' - 100'
Downstream (Termination)	Varies (See Drawings)

★ Use Pre-Construction Posted Speed to select the Speed from the Tables below:

★ SPEED (mph)	MINIMUM FLARE RATE
≤ 30	8:1
35	9:1
40	10:1
45	12:1
50	14:1
55	16:1
60	18:1
65	19:1
70	20:1

MINIMUM LENGTHS TABLE

★ SPEED (mph)	"L" VALUE FOR TAPERS (ft)			BUFFER "B" (ft)		
	W = Lane or Shoulder Width being closed or shifted	W = 10'	W = 14'	W = 16'	W = 18'	W = 20'
25	105	125	145	165	185	205
30	150	180	210	240	270	300
35	205	245	285	325	365	405
40	265	320	375	430	485	540
45	450	540	630	720	810	900
50	500	600	700	800	900	1000
55	550	660	770	880	990	1100
60	600	720	840	960	1080	1200
65	650	780	910	1040	1170	1300
70	700	840	980	1120	1260	1400
FREEWAYS						
55	1000	1000	1000	1000	1000	250
60	1000	1000	1000	1000	1000	285
65	1000	1000	1000	1000	1000	325
70	1000	1000	1000	1000	1000	365

NOTES:  
 • For Lane closures where W < 10', use "L" value for W = 10'.  
 • For Shoulder closures where W < 10', use "L" value for W = 10' or calculate "L" using formula, for Speeds ≥ 45; L = WS, Speeds < 45; L = S<sup>2</sup>/W/60, S = Speed, W=Width

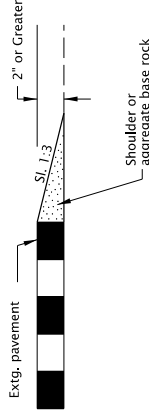
TRAFFIC CONTROL DEVICES (TCD) SPACING TABLE

★ SPEED (mph)	Sign Spacing (ft)			Max. Channelizing Device Spacing (ft)
	A	B	C	
20 - 30	100	100	100	20
35 - 40	350	350	350	20
45 - 55	500	500	500	40
60 - 70	700	700	700	40
Freeway	1000	1500	2640	40

NOTES:  
 • Place traffic control devices on 10 ft. spacing for Intersection and access radii.  
 • When necessary, sign spacing may be adjusted to fit site conditions.  
 • Limit spacing adjustments to 30% of the "A" dimension for all speeds.

NOTES:

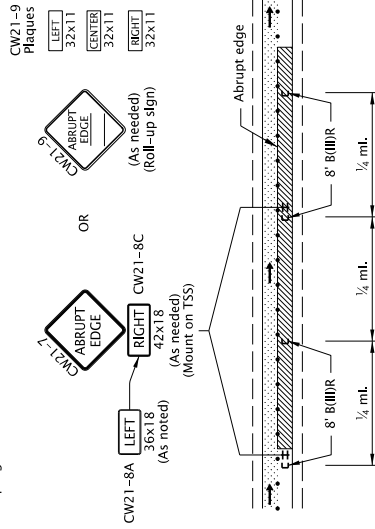
- When paved shoulders adjacent to excavations are less than four feet wide protect longitudinal abrupt edge as shown.
- Use aggregate wedge when abrupt edge is 2 inches or greater.



EXCAVATION ABRUPT EDGE

NOTES:

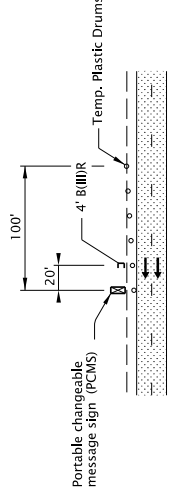
- Abrupt edges may be created by paving, operations, excavations or other roadway work. Use abrupt edge signing for longitudinal abrupt edges of 1' Inch or greater.
- If the excavation is located on left side of traffic, replace the 8' 8(I)M/R barricades with 8' 8(I)M/R barricades and replace the "RIGHT" (CW21-8C) signs with "LEFT" (CW21-8A) signs.
- Continue signing and other traffic control devices throughout excavation area at spacings shown.
- If roll-up signs are used, attach the correct (CW21-9) Plaques to the sign face using hook and loop fasteners. Place roll-up signs in advance of barricades.



TYPICAL ABRUPT EDGE DELINEATION

NOTES:

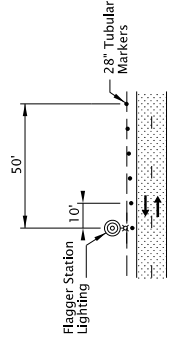
- Install PCMS beyond the outside shoulder, when possible.
- Use the appropriate type of barricade panels for PCMS location. Right shoulder, use Type 8(I)M/R Left shoulder, use Type 8(I)M/L
- Use six drums in shoulder taper on 20' spacing. The drums and barricade may be omitted when PCMS is placed behind a roadside barrier.
- Detail as shown is used for trailered and non-crashworthy components of:
  - Portable Traffic Signals
  - Smart Work Zone Systems



PORTABLE CHANGEABLE MESSAGE SIGN (PCMS) INSTALLATION

NOTES:

- Install Flagger Station Lighting beyond the outside shoulder, where practical.
- Use six tubular markers in shoulder taper on 10' spacing.
- Place cart / generator / power supply off of the shoulder, as far as practical.



FLAGGER STATION LIGHTING DELINEATION

GENERAL NOTES FOR ALL TCP DRAWINGS:

- Signs and other Traffic Control Devices (TCD) shown are the minimum required.
- Place a barricade approx. 20' ahead of all sequential arrow boards.
- Arrows shown in roadway are directional arrows to indicate traffic movements.
- All signs are 48" x 48" unless otherwise shown. Use fluorescent orange sheeting for the background of all temporary warning signs.
- All diamond shaped warning signs mounted on barrier sign supports shall be 36" by 36". All other signs mounted on barrier sign supports shall not exceed 12 sq. ft. in total sign area.
- Low speed highways have a pre-construction posted speed of 40 mph or less. High speed highways have a pre-construction posted speed of 45 mph or higher.
- Do not locate sign supports in locations designated for bicycle or pedestrian traffic.
- Combine drawing details to complete temporary traffic control for each work activity.
- Coordinate and control pedestrian movements through a Temporary Accessible Route using Flaggers, Traffic Control Measures, or as directed.
- To be accompanied by Dwg. Nos. TM820 & TM821.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without first consulting a Registered Professional Engineer.

OREGON STANDARD DRAWINGS

TABLES, ABRUPT EDGE AND PCMS DETAILS

DATE	REVISION	DESCRIPTION
07-2022	Added a note for TMS.	
		2024
CALC.		
BOOK NO.	N/A	SOR DATE: 05-JUL-2022
		TM800

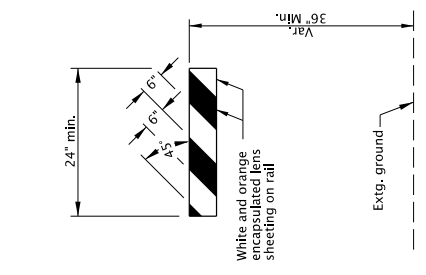
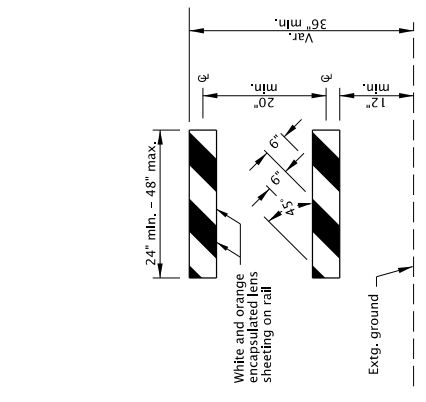
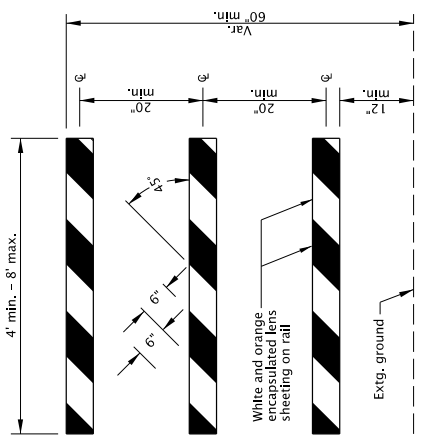
Effective Date: December 1, 2023 – May 31, 2024

<p>temp. reflective pvmt. markers</p> <p>4" wide stripes</p> <p>10'</p>	<p><b>LAYOUT "A"</b> (Supplemented double solid lines)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>To prohibit lane changes or passing (include appropriate regulatory signs).</li> <li>Freeway or multilane shifts and crossovers.</li> <li>For projects in place through winter months.</li> <li>Two-lane, two-way centerlines.</li> </ul>
<p>temp. reflective pvmt. markers</p> <p>4" wide stripe</p> <p>10'</p>	<p><b>LAYOUT "B"</b> (Supplemented solid line)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>Alignment shifts or crossovers.</li> <li>To discourage lane changes in multilane sections.</li> <li>For projects in place through winter months.</li> </ul>
<p>temp. reflective pvmt. markers</p> <p>10 ft. x 4 in. stripe</p> <p>15'</p> <p>15'</p> <p>40'</p>	<p><b>LAYOUT "C"</b> (Supplemented broken lines)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>Freeway and multilane broken lines.</li> <li>High ADT 2 lane roads (greater than 10,000).</li> <li>For projects in place through winter months.</li> </ul>
<p>Temp. reflective or flexible pvmt. markers</p> <p>40'</p> <p>30'</p> <p>5'</p> <p>5'</p>	<p><b>LAYOUT "D"</b> (Simulated broken lines)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>During staging on finished/existing surfaces.</li> <li>HMAC intermediate surfaces.</li> <li>Emulsified asphalt surface treatments (chip seals) where permanent pavement markings cannot be placed within two weeks.</li> </ul>
<p>Temp. reflective pvmt. markers</p> <p>10'</p>	<p><b>LAYOUT "E"</b> (Simulated Solid Lines)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>Alignment shifts or crossovers.</li> <li>To discourage lane changes in multilane sections.</li> <li>Edge lines for short durations, less than 14 days.</li> </ul>
<p>temp. reflective pvmt. markers</p> <p>4" wide stripes</p> <p>40'</p>	<p><b>LAYOUT "F"</b> (Supplemented wide double solid lines)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>To prohibit lane changes or passing (include appropriate regulatory signs).</li> <li>2 lane, 2 way centerlines.</li> <li>2 lane, 1 way alignments on freeways or multi-lane highways.</li> </ul>
<p>8" wide stripe</p> <p>2" space</p> <p>Double temp. reflective markers on 10' spacings</p> <p>2" space</p>	<p><b>LAYOUT "G"</b> (Supplemented solid 8" line)</p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>Core areas</li> <li>Alignment splits (bifurcations)</li> </ul>
<p><b>GENERAL NOTES FOR ALL DETAILS:</b></p> <ul style="list-style-type: none"> <li>When using Supplemented or Simulated lines: <ul style="list-style-type: none"> <li>1. Yellow Bi-Directional Pavement Markers are required for Two-Way Traffic.</li> <li>2. White Mono-Directional Pavement Markers are required for one-way traffic or edge lines.</li> </ul> </li> <li>Supplemented lines are painted lines enhanced with Reflective Pavement Markers.</li> <li>Simulated lines are Reflective Pavement Markers placed in a pattern to substitute for a painted line.</li> <li>Pavement marking colors shall conform to the MUTCD.</li> </ul>	<p><b>TEMPORARY PAVEMENT MARKINGS</b></p> <p><b>OREGON STANDARD DRAWINGS</b></p> <p><i>The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without first consulting a Registered Professional Engineer.</i></p> <p><b>TYPICAL APPLICATIONS:</b></p> <ul style="list-style-type: none"> <li>All materials shall be in accordance with the current Oregon Standard Specifications.</li> </ul> <p><b>TEMPORARY PAVEMENT MARKINGS</b></p> <p>DATE: _____ YEAR: 2024</p> <p>REVISION DESCRIPTION: _____</p> <p>CALC. _____ SDR _____</p> <p>BOOK NO. _____ N/A _____ DATE: 05-JUL-2020 _____</p> <p><b>TMS10</b></p>

Effective Date: December 1, 2023 – May 31, 2024

**GENERAL NOTES FOR ALL DETAILS:**

- Sandbags (approximately 25 lb sack filled with sand) may be placed on lower frame to provide additional ballast.
- Ballast shall not extend above bottom rail or be suspended from barricade.
- For rails less than 36" long, 4" wide stripes shall be used.
- Rails must be 8" min. to 12" max. in height.
- Use barricades from ODOT Qualified Products List (QPL).
- Use 4" Type III barricades where horizontal space is limited.
- Do not block bike lanes or shoulders unless the facility is properly closed and signed.
- Do not place barricades in sidewalks unless sidewalk is closed and a temporary pedestrian accessible route (TPAR) is signed according to the TCP. See Dwg. No. TM844.



**TYPE III**

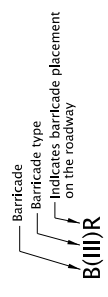
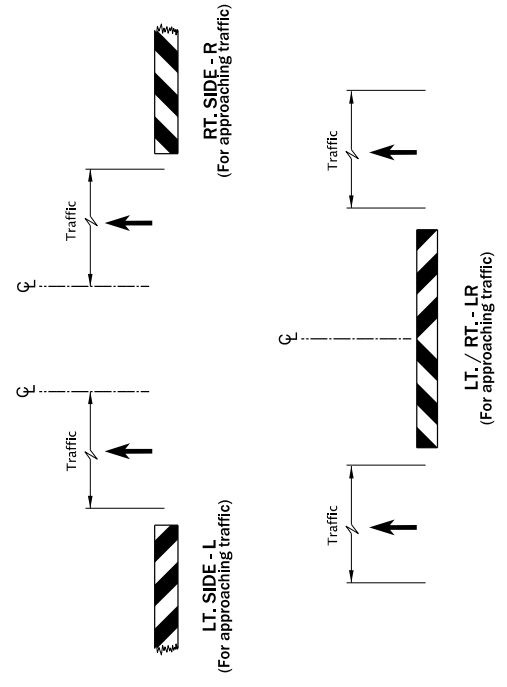
**TYPE II**

**TYPE I**

**BARRICADE RAIL LAYOUT**

**NOTES:**

- Markings for barricade rails shall slope downward at an angle of 45° in the direction traffic is to pass.
- Where a barricade extends entirely across a roadway, it is desirable that the stripes slope downward in the direction toward which traffic must turn in detouring.
- Where both right and left turns are provided for, slope the chevron striping downward in both directions from the center of the barricade.
- For full roadway closures, the C or LR barricade may be used. Extend barricades completely across roadway unless access is required for local road users.



**BARRICADE NOTATION**

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All materials shall be in accordance with the current Oregon Standard Specifications.

**OREGON STANDARD DRAWINGS**

**TEMPORARY BARRICADES**

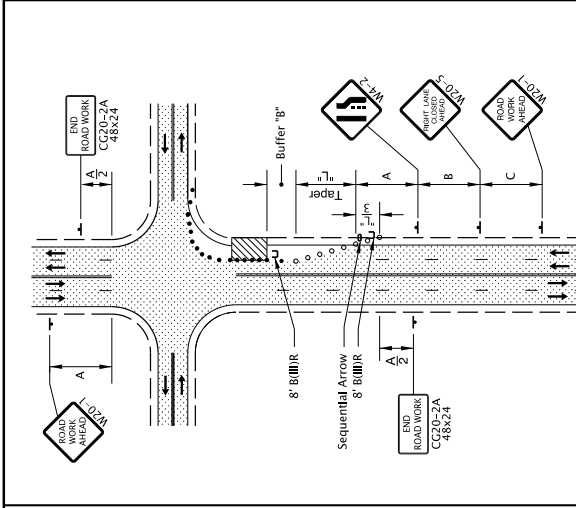
2024

DATE	REVISION DESCRIPTION

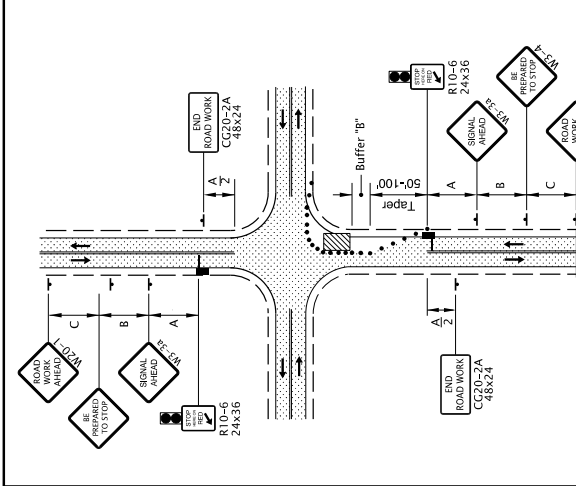
CALC.	N/A	SOR	05-JUL-2020	TM820
BOOK NO.		DATE		

**DIAGRAM FOR BARRICADE PLACEMENT AND SLOPE MARKING**

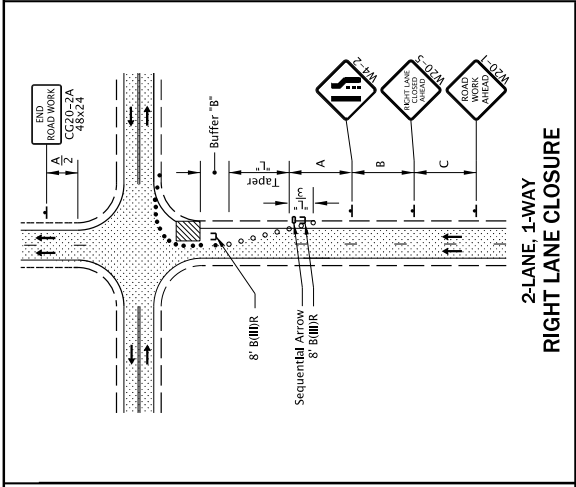
Effective Date: December 1, 2023 – May 31, 2024



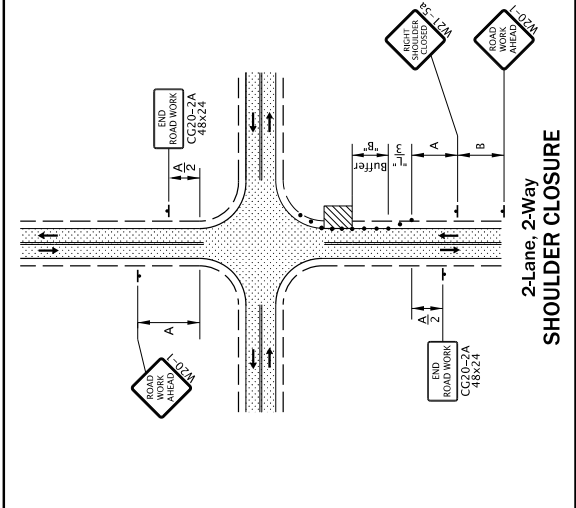
**2-Lane, 2-Way SHOULDER CLOSURE**



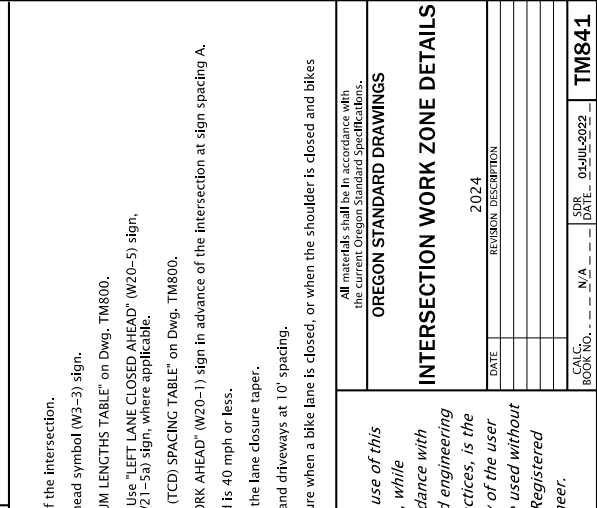
**2-Lane, 2-Way ONE LANE CLOSURE**



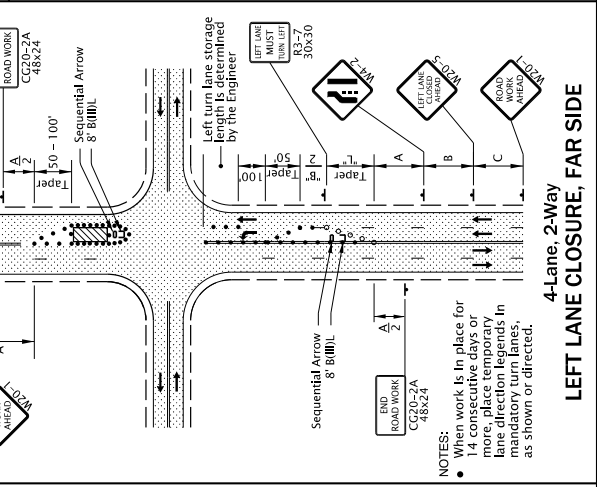
**2-Lane, 1-Way RIGHT LANE CLOSURE**



**4-Lane, 2-Way RIGHT LANE CLOSURE, FAR SIDE**



**4-Lane, 2-Way RIGHT LANE CLOSURE, NEAR SIDE**



**4-Lane, 2-Way LEFT LANE CLOSURE, FAR SIDE**



**4-Lane, 2-Way RIGHT LANE CLOSURE, FAR SIDE**

**GENERAL NOTES FOR ALL DETAILS:**

- Additional Traffic Control Measures (TCM) may be required for all legs of the intersection.
- The "SIGNAL AHEAD" (W3-3a) sign may be substituted with the signal ahead symbol (W3-3) sign.
- To determine Taper Length ("L") and Buffer Length ("B"), use the "MINIMUM LENGTHS TABLE" on Dwg. TM800.
- For left lane or shoulder work, place TCD to close left lane or shoulder. Use "LEFT LANE CLOSED AHEAD" (W20-5) sign, "LEFT LANE ENDS" (W4-2L) symbol sign, or "LEFT SHOULDER CLOSED" (W21-5a) sign, where applicable.
- To determine sign spacing A, B, and C, use "TRAFFIC CONTROL DEVICES (TCD) SPACING TABLE" on Dwg. TM800.
- When a through road intersects within the work zone, place a "ROAD WORK AHEAD" (W20-1) sign in advance of the intersection at sign spacing A.
- Tubular markers may be used in lane closure tapers where posted speed is 40 mph or less.
- Where shoulder width is limited, Sequential Arrow may be placed within the lane closure taper.
- Place channelizing devices around intersection radii, business accesses and driveways at 10' spacing.
- Install a "BICYCLES ON ROADWAY" (CW11-1) sign in advance of the closure when a bike lane is closed, or when the shoulder is closed and bikes are expected.
- To be accompanied by Dwg. Nos. TM820, TM82, TM840 & TM854.

**INTERSECTION WORK ZONE DETAILS**

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without first consulting a Registered Professional Engineer.

All materials shall be in accordance with the current Oregon Standard Specifications.

**OREGON STANDARD DRAWINGS**

Automated Flagging Assistance Device (AFAD)

28" Tubular Markers See TCD Spacing Table on TM800 for max. spacing.

Temp. Plastic Drums See TCD Spacing Table on TM800 for max. spacing.

UNDER TRAFFIC

UNDER CONSTRUCTION

DATE	REVISION	DESCRIPTION
2024		

CALC. BOOK NO. N/A SOR DATE: 05-JUL-2022 TM841

Effective Date: December 1, 2023 – May 31, 2024

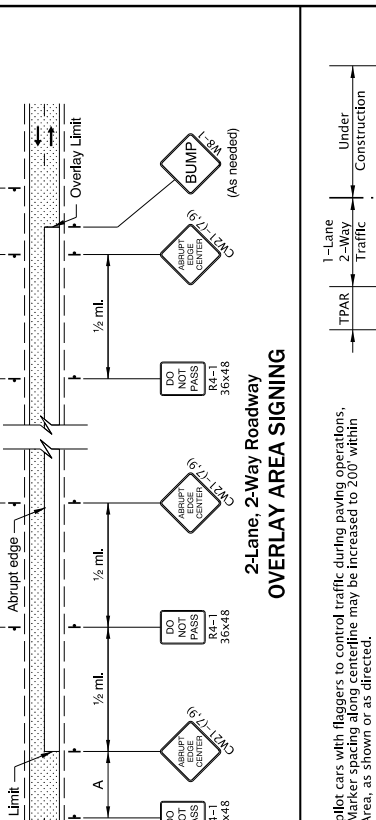
OREGON STANDARD DRAWINGS	
<b>2-LANE, 2-WAY ROADWAYS</b>	
DATE	REVISION DESCRIPTION
01-2022	Added AFDs to drawings.
2024	

**ALL materials shall be in accordance with the current Oregon Standard Specifications.**

*The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without first consulting a Registered Professional Engineer.*

CALC.		BOOK NO.		DATE	
		N/A		05-JUL-2022	
SJR				TM850	

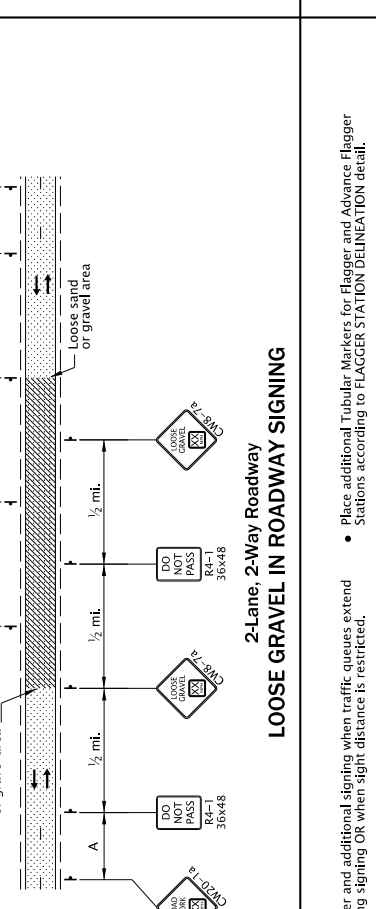
Effective Date: December 1, 2023 - May 31, 2024



**2-Lane, 2-Way Roadway OVERLAY AREA SIGNING**

**NOTE:**

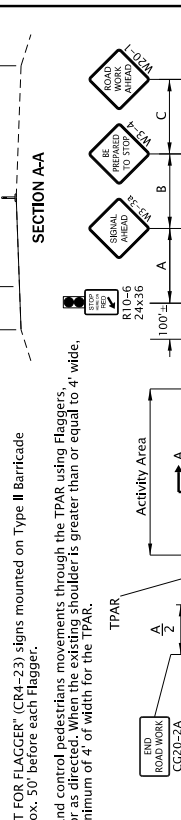
- Continue "ABRUPT EDGE" (CW21-(7,9)) and "DO NOT PASS" (R4-1) signing throughout the area at spacing shown.
- Use advisory speed "XX", 15 mph less than the posted speed or "XX MPH" placard shall not exceed a posted speed of 35 mph.



**2-Lane, 2-Way Roadway LOOSE GRAVEL IN ROADWAY SIGNING**

**NOTE:**

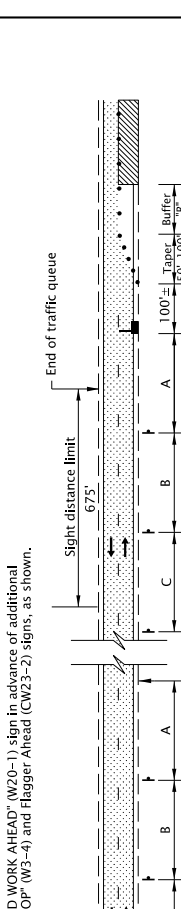
- Place Advance Flagger and additional signing when traffic queues extend beyond initial warning signing OR when sight distance is restricted.
- Relocate initial "ROAD WORK AHEAD" (W20-1) sign in advance of additional "BE PREPARED TO STOP" (W3-4) and Flagger Ahead (CW23-2) signs, as shown.



**2-Lane, 2-Way Roadway ONE LANE CLOSURE**

**NOTE:**

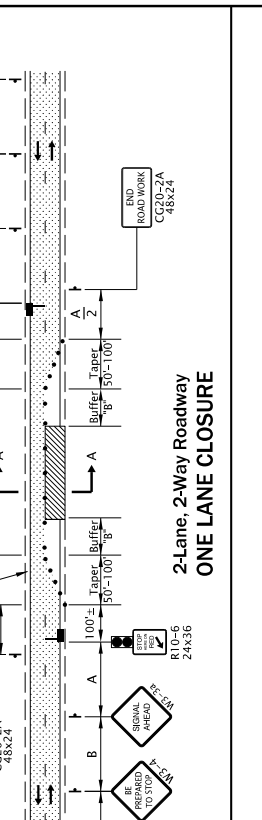
- When using pilot cars with flaggers to control traffic during paving operations, the Tubular Marker spacing along centerline may be increased to 200' within the Activity Area, as shown or as directed.
- Includes "WAIT FOR FLAGGER" (CS4-23) signs mounted on Type II Barricade located approx. 50' before each flagger.
- Coordinate and control pedestrians movements through the TPAR using Flaggers, other TCM, or as directed. When the existing shoulder is greater than or equal to 4' wide, provide a minimum of 4' of width for the TPAR.



**2-Lane, 2-Way Roadway ADVANCE FLAGGER FOR EXTENDED TRAFFIC QUEUES**

**GENERAL NOTES FOR ALL DETAILS:**

- The "SIGNAL AHEAD" (W3-3a) sign may be substituted with the Signal Ahead (W3-3) symbol sign.
- Cover existing passing zone signing, as directed.
- Install temporary striping as required.
- To determine Taper Length ("L") and Buffer Length ("B"), use the "MINIMUM LENGTHS TABLE", shown on Dwg. No. TM800.
- To determine sign spacing A, B, and C, use "TRAFFIC CONTROL DEVICES (TCD) SPACING TABLE" on Dwg. No. TM800.
- Install a "BICYCLES ON ROADWAY" (CW11-1) sign in advance of the closure when a bike lane is closed, or when the shoulder is closed and bikes are expected.
- At night, flagger stations shall be illuminated according to the FLAGGER STATION LIGHTING DELINEATION detail on Dwg No. TM800.



**2-Lane, 2-Way Roadway FLAGGER STATION DELINEATION**

**NOTE:**

- Use a minimum of 3 tubular markers in shoulder taper on 10' spacing for flagger station delineation.

**2-Lane, 2-Way Roadway ADVANCE FLAGGER FOR EXTENDED TRAFFIC QUEUES**

**NOTE:**

- To be accompanied by Dwg. Nos. TM820, TM821 & TM854.
  - Automated Flagging Assistance Device (AFAD)
- 28" Tubular Markers on 20' max. spacing for flagger tapers and stations
- 28" Tubular Markers See TCD Spacing Table on TM800 for max. spacing.

**UNDER TRAFFIC** (indicated by a dotted pattern)

**UNDER CONSTRUCTION** (indicated by a diagonal line pattern)

**CONSTRUCTION UNDER TRAFFIC** (indicated by a cross-hatch pattern)

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**TECHNICAL SPECIFICATIONS**  
**SECTION 2**  
**EXCAVATION AND BACKFILL OF TRENCHES**

**PART 1 - GENERAL**

**1.1 Summary**

These Specifications cover the excavation and backfill of trenches for the installation of storm sewer, sanitary sewer, water lines, service lines, pressure sewer lines, and other underground utilities.

**1.2 Definitions**

- A. Foundation material or stabilization fabric will only be required when standard bedding requirements will not adequately support the pipe.
- B. Backfill is the filling of the trench to the existing ground level or the finish grade line shown on the Drawings.
- C. General trench excavation shall include whatever materials that are encountered (except solid rock) to the depths shown on the Drawings or as required to properly install the pipe.
- D. Solid Rock
  - 1. Solid rock is defined as being rock formations other than cemented gravels that require hard ripping, jackhammering, blasting, or other extra work beyond the capability of medium duty trench excavating equipment such as a John Deere 135 or similar, with ripper attachment.
  - 2. Cemented gravel excavation may be included as "Rock Excavation" when said excavation requires hard ripping, jackhammering, or blasting and ONLY when, in the opinion of the Engineer, such conditions were unforeseen and are beyond the capability of medium duty trench excavating equipment such as a John Deere 135 or similar, with ripper attachment.

**1.3 Safety**

- A. See requirements for Project safety in the General Conditions and General Requirements.
- B. The determination of the safe trench width is the sole responsibility of the Contractor.

**TECHNICAL SPECIFICATIONS**  
**SECTION 2**  
**EXCAVATION AND BACKFILL OF TRENCHES**

**1.4 Existing Utilities**

See the General Conditions and General Requirements for Contract requirements for existing utilities and for preservation of survey monumentation.

**1.5 Dust and Mud Control**

- A. The Contractor shall take appropriate action to control dust and mud caused by their operations. This shall include, but not be limited to, watering of exposed areas, cleaning of roadways, etc. This is considered a normal part of the construction Project.
- B. No measurement or payment shall be made for this Work.

**1.6 Soil and Groundwater Conditions**

- A. Soils data and groundwater conditions, when shown on the Drawings, are provided for the Contractor's information, may not be relied upon, and are a general description only. This information may or may not be shown. The Engineer assumes no responsibility for actual soil conditions.
- B. Soils data and groundwater conditions, when shown, shall not relieve the Contractor from the responsibility of making additional investigations. The Contractor shall perform investigations as they deem necessary to acquaint themselves with actual conditions to be encountered in performing the Work. Groundwater conditions in particular should be carefully considered and are subject to change.

**PART 2 - MATERIALS**

**2.1 Foundation Material**

Foundation material shall be well-graded 2-1/2"-0 or 1-1/2"-0 crushed rock.

**2.2 Bedding and Select Backfill**

- A. Bedding and select backfill shall be well-graded 3/4"-0 or 1"-0 crushed rock or approved equal. All bedding and select backfill materials shall be subject to the approval of the Engineer.

**2.3 General Backfill**

- A. General backfill will consist of material excavated from the trench, or material imported by the Contractor. General backfill material shall be free of vegetative matter, boulders



## TECHNICAL SPECIFICATIONS

### SECTION 2

#### EXCAVATION AND BACKFILL OF TRENCHES

- (8-inch plus), frozen material and any other unsuitable material, and shall have a moisture content that will allow for the required compaction of the general backfill material unless approved otherwise by the Engineer. Use of backfill material containing consolidated masses 8-inch in diameter or greater is prohibited.
- B. When necessary, the Contractor shall selectively separate suitable general backfill material from unsuitable general backfill material.
  - C. When the Engineer determines that the native material excavated from the trench is unsuitable or unacceptable for use as general backfill, the Engineer may require the Contractor to remove the unsuitable material from the Project Site and import suitable general backfill material. Suitable material shall be similar in nature to native soils as approved by the Engineer. When imported general backfill must be placed in or below the groundwater, the imported general backfill shall be free draining granular material with less than 20 percent passing a No. 4 sieve and less than 3 percent passing a No. 200 sieve.

#### 2.4 Controlled Density Fill (CDF)

- A. CDF material shall be a flowable cement, sand or pea gravel, and Fly Ash Pozzolanic, or other approved materials, mixture that contains 75 to 120 pounds of Type II cement per cubic yard.
- B. The sand and other aggregates shall generally conform with the requirements of ASTM C33.
- C. Air-entraining agent shall be added at the rate of 3 to 5 oz. per cubic yard.
- D. The material shall have a 28-day compressive strength of 100 to 200 psi and have a slump of 7 inches plus or minus 1-1/2 inches at the time of placement. The Contractor shall provide a mix design and data on the CDF material they propose to use along with typical compression test results.

#### 2.5 Anti-Flotation, Dewatering and Trench Stabilization Fabrics

- A. Fabric for anti-flotation and dewatering shall be Mirafi 500X or approved equal.
- B. Fabric for trench stabilization shall be Mirafi 140N Fabric or approved equal.

**TECHNICAL SPECIFICATIONS**  
**SECTION 2**  
**EXCAVATION AND BACKFILL OF TRENCHES**

**PART 3 - EXECUTION**

**3.1 Clearing and Grubbing**

- A. Contractor shall do all clearing and grubbing and removal of structures, etc. necessary to permit proper installation of the pipeline and to eliminate the possibility of stumps, logs, brush, or rubbish being mixed with the backfill material. A sufficient amount of all stumps and stump roots shall be removed so that any future removal of any remaining parts of the stumps and/or roots will not damage the pipeline. All stumps, roots, logs, brush and rubbish shall be removed and disposed of in conformance with the requirements of local authorities controlling air pollution, and solid waste disposal.
- B. Should the area in which construction takes place be served by rural mail carrier service, the Contractor shall cooperate with the mail service and re-install, in a convenient location, any rural mail boxes which will have to be removed or be blocked by construction operations. As soon as the Work is completed, all mail boxes removed shall be replaced undamaged in their original location.
- C. As soon as the Work is completed, all signs, guardrails, utility poles, fences, etc., that were moved for the construction operation shall be replaced undamaged in their original location. Damaged items shall be replaced by the Contractor with new items of equal quality.

**3.2 Cutting of Asphalt Pavement and Concrete Sidewalks, Curbs and Driveways**

- A. Where the excavation is made in a paved street, the asphalt surface shall be cut on each side of the trench prior to excavation, to provide a vertical joint in the surface. Cutting of the asphalt will be made with a saw designed for the cutting of asphalt.
- B. The use of a jackhammer, wheel cutter, or other similar tool may be allowed by the Engineer only where the Contractor can demonstrate that the alternate method provides a neat straight edge.
- C. Prior to excavating across a concrete structure such as a curb, sidewalk, or driveway, the Contractor shall cut and remove a section of the structure to provide for their excavation. The dimensions of the removed section shall be such that the Contractor's excavation will not result in undermining of the remaining structure.
- D. The Contractor shall cut the concrete structure with a diamond saw or other equipment designed for that purpose such that a neat, straight, vertical edge is left on the

## TECHNICAL SPECIFICATIONS

### SECTION 2

#### EXCAVATION AND BACKFILL OF TRENCHES

remaining concrete structure. The Contractor shall similarly cut and remove any such concrete structure undermined or damaged by their construction work.

- E. Following proper backfill and compaction of their excavation, as specified herein, the Contractor shall repair streets, replace the curbs, sidewalks, or driveways in conformance with the Drawings, or, if no Drawing is provided, equal to the condition prior to removal.

#### 3.3 Trench Excavation

##### A. General

When solid rock is encountered in trench excavation, the Engineer shall be notified.

##### B. Trench Width

1. The maximum trench width in the pipe zone shall be 2 feet plus the O.D. of the pipe and the minimum trench width in the pipe zone shall be 1 foot plus the O.D. of the pipe. This width shall be maintained to the top of the pipe.
2. The maximum clear width above the top of the pipe will not be limited except in cases where excess width of excavation would cause damage to adjacent structures or utilities.

##### C. Unsuitable Material

1. When natural soil conditions exist in the bottom of the trench that are unsuitable for proper pipe installation, the Contractor shall immediately notify the Engineer. The Contractor shall then over-excavate the trench below the design grade to a depth specified by the Engineer. Such over-excavation shall be to provide for foundation material as specified herein. No additional payment will be made to the Contractor for additional excavation without prior approval of the Owner.
2. Foundation material or stabilization fabric, as shown on the Drawings, shall be provided by the Contractor only when specifically called for on the Drawings or in these Specifications or when required by the Engineer. No additional payment will be made to the Contractor for foundation material or stabilization fabric placed without prior written approval of the Owner of such additional payment.
3. As an alternative to over-excavation and placement of foundation material, a geotextile fabric may be used if field use proves acceptable. The fabric material

## TECHNICAL SPECIFICATIONS

### SECTION 2

#### EXCAVATION AND BACKFILL OF TRENCHES

shall be placed on the bottom of the trench and the bedding material placed over the fabric to proper pipe grade. The fabric width shall be one foot wider than the trench bottom.

D. **Exploratory Work**

Contractor shall perform appropriate exploratory work to locate utilities when they are known to exist but the specific location is unknown or not marked accurately. Appropriate exploratory work shall be performed in these situations.

#### **3.4 Shoring, Sheeting, and Bracing of Trenches**

- A. The Contractor shall adequately sheet and brace the trench during excavation whenever necessary to satisfy trench safety standards, prevent cave-ins, or to protect adjacent structures or property. Where sheeting and bracing are used, the Contractor shall increase trench widths for the bracing material accordingly.
- B. The sheeting must be kept in place until the pipe has been placed, backfilled at the pipe zone, tested for defects, and repaired if necessary. All sheeting, shoring, and bracing of trenches shall conform to the requirements of the public agency having jurisdiction.

#### **3.5 Dewatering Excavated Areas**

- A. All groundwater, seepage, or stormwater that may occur or accumulate in the excavation during the progress of the Work shall be removed. In areas where the nature of soil and hydrostatic pressures are of such a character as to develop a quick condition in the earth mass of the trench, the dewatering operation shall be conducted so that the hydrostatic pressure will be reduced to or near zero in the immediate vicinity of the trench.
- B. All excavations shall be kept free of water during the construction or until otherwise requested by the Engineer.
- C. Contractor shall dispose of all waste and water removed from the trench. Disposal shall be in accordance with all state and local regulations.

#### **3.6 Location of Excavated Materials**

- A. During trench excavation, the excavated material shall be located within the construction easement or right-of-way so that the excavated material will not obstruct any private or public traveled roadways or streets, or cause undue damage to the streets.

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- B. Contractor shall provide means of containing overly saturated soils, i.e., muck, or remove the muck from the Work area as it is excavated, if such soils are encountered in the excavation. The intent is to prevent excessive damage or disruption to street rights-of-way or easement beyond what would normally occur during such Work. Pile and maintain material from trenches so that the toe of the slope of the material excavated is at least two feet from the edge of the trench. It shall be the Contractor's responsibility, however, to determine the safe loading of all trenches.

#### 3.7 Disposal of Excavated Materials

Contractor shall dispose of all excavated material, which is not required for, or is unsuitable for, backfill. The Contractor's method of disposal shall comply with regulations of the governing body having jurisdiction.

#### 3.8 Trench Backfill

- A. All backfill material shall be placed into the trench so that free fall of the materials into the trench is prevented until at least 6-inches of cover is provided over the pipe. Under no circumstances shall sharp or heavy pieces of material be allowed to drop directly onto the pipe. Methods of backfilling, other than as specified herein, shall be used only upon the approval of the Engineer.
- B. Bedding and Select Backfill
  1. A minimum 4-inch depth of bedding shall be placed on the trench bottom, compacted to 85 percent of the maximum density as determined by ASTM D698, and smoothed to provide uniform bedding so the pipe is supported along its full length and not by the bells. Bell holes at each joint shall be provided to ensure support along the entire pipe length.
  2. It shall be understood that the 4-inch depth is a minimum depth only, not an average depth, and does not preclude the Contractor at their option from placing additional depth of bedding to facilitate their Work. Once the pipe is properly installed, the bedding material shall be brought up to the spring line of the pipe in 6-inch lifts and compacted to 85 percent density. Care shall be used to ensure that the bedding material is properly worked under the haunch of the pipe for its full length. No additional payment will be made to the Contractor should they elect to use additional bedding material for their convenience. Payment for any additional bedding material used as foundation material must be approved by the Owner prior to any Work being performed.

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3. Select backfill shall then be brought up from the spring line to the minimum distance above the top of the pipe shown on the Drawings, leveled and compacted to 85 percent of ASTM D698 density. Compaction of the bedding and select backfill by hand tamping will be allowed if the 85 percent density is achieved; otherwise, mechanical tamping will be required.
  4. When an open-graded material is used for bedding or foundation material to facilitate trench dewatering, the open graded material shall be placed to the spring line of the pipe. The Contractor shall make provisions to ensure that fines from the select backfill do not migrate into the open graded bedding or foundation material. To prevent soil migration the Contractor may use any of the following:
    - a. Provide a properly graded select backfill approved by the Engineer;
    - b. Provide an approved fiber/fabric between the open graded bedding material and select backfill;
    - c. Hydraulically jet select backfill fines into open graded bedding material after dewatering is complete and before general backfill is placed; or
    - d. Provide an alternative approved by the Engineer.
- C. All general backfill material shall be pushed first onto the slope of the backfill previously placed and allowed to roll down into the trench. The Contractor shall not push the backfill material directly into the trench until at least 6 inches of cover is provided over the pipe. General backfill shall be compacted in 6-inch to 12-inch lifts and compacted to 85 percent of ASTM D698.
- D. Compaction
1. In roadways, driveways, under curbs and sidewalks, as shown on the Drawings, or as required by the Engineer, general backfill shall be placed in horizontal lifts not to exceed 12 inches in depth and compacted to 90 percent of the laboratory density as determined by ASTM D1557, as applicable. In Jackson County rights-of-way, trench backfill shall be placed and compacted as specified by the Jackson County Construction Standards. The method of compaction shall be selected by the Contractor.
  2. The Contractor shall exercise extreme care to avoid damage to the pipe during compaction of the trench. Where materials consist of cobbles and coarse

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gravels, compaction of each lift shall be accomplished by at least five passes of an appropriate vibrating type compactor. When materials are such that meaningful in place density test cannot be run, then the Contractor and Engineer will agree on a method of compaction which will provide adequate compaction.

3. In sections where specific compaction requirements are not specified or required by the Engineer, general backfill shall be compacted, as a minimum, to a density equal to that of the natural ground adjacent to the trench. All trenches shall be maintained for a period of one year after final acceptance of the Project. Any settlement of the trenches during the one-year guarantee period shall be remedied promptly at the request of the Engineer and at no additional cost to the Owner.
- E. CDF Placement
1. *Not Used*
- F. Canal or Irrigation Ditch Crossing
1. Where the trench crosses a canal, irrigation ditch or culvert, the backfill shall be compacted the entire trench depth with mechanical tampers to 90 percent of the laboratory density as determined by ASTM D1557.
  2. All backfill material in the canal or ditch liner and in the trench cut-off wall shall be imported clay or a soil/bentonite mixture as approved by the Engineer. Unless required otherwise, the soil/bentonite mixture shall be 1 part bentonite to 10 parts soil by weight. A high grade bentonite material shall be used.
  3. The ditch lining, conduit or pipe shall be restored to its original condition. The crossing shall be water tight and free of any leakage or seepage. The Contractor shall be fully responsible for repairing canal or ditch banks at no cost to the Owner should leakage occur at the crossing.
- G. Anti-Flotation Fabric Placement
1. When called for on the Drawings or called for by the Engineer, the Contractor shall place geotextile fabric over the select backfill material prior to placing general backfill. This fabric will help reduce the exposure to pipeline flotation.
  2. The fabric shall be placed in accordance with the requirements shown on the Drawings.

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##### 3.9 Execution of Dust and Mud Control

If the Contractor fails to properly control the dust and mud, the Engineer may request them to do so in writing. If, after 24 hours from this request, the Contractor has not corrected the dust or mud problem, the Owner may elect to have the corrective work performed and withhold the cost from the Contractor's payments.

##### 3.10 Restoration, Finishing, and Cleanup

- A. The Contractor shall restore or replace all paved surfaces, graveled surfaces, curbing, sidewalks, trees and shrubbery, lawns, pastures and fences, or other existing facilities disturbed by their Work unless otherwise specified. Restoration and cleanup shall be a continuing operation and shall be diligently pursued until completed.
- B. All surplus material and temporary structures as well as excess excavation shall be removed by the Contractor and the entire Site of Contractor operations shall be left in a neat and clean condition.
- C. Surface restoration shall be performed in accordance with Technical Specifications - "Surface Restoration." All other existing facilities shall be replaced or restored equal to their original condition.

#### PART 4 - MEASUREMENT AND PAYMENT

##### 4.1 Basis of Measurement and Payment

- A. Unless specifically listed in the Bid Schedule, there will be no measurement or payment made for general trench excavation, backfill of trenches, including bedding and select backfill. All costs shall be included in other appropriate bid items listed in the Bid Schedule.
- B. Payment for Work performed by the Contractor shall be paid for under the following bid items when listed in the Bid Schedule: "Repair of Unmarked Water Main," "Repair of Unmarked Sewer Main," "Repair of Unmarked Water Service Line," and "Repair of Unmarked Sewer Service Line." When specific repair work is not listed in the Bid Schedule, required repair work will be paid for by an approved Change Order. There shall be no payment for damaged water lines or sewer lines that have been marked by the Owner prior to excavation and are within the four feet specified. When rock excavation is required to complete the Work and unit prices for rock excavation are not included in the Bid Schedule, rock excavation shall be performed by Change Order.



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**4.2 Foundation Material and Stabilization Fabric**

- A. When foundation material or stabilization fabric is listed in the Bid Schedule, the bid price shall include payment for all excavation (excluding rock) embankment and compaction, or fabric, etc., as required. When foundation material or stabilization fabric is required by the Engineer in areas not identified on the Drawings or in the Specifications, said Work will be performed by Change Order unless a unit price for said Work has been included in the Bid Schedule.
- B. When fabric is used in lieu of foundation material, it will be paid under the bid item "Trench Stabilization Fabric" when listed in the Bid Schedule or by Change Order if not listed as a bid item. Payment will be on a square yard basis.

**4.3 Surface Restoration**

The Contractor should note the pay limits of gravel and asphalt restoration listed under Technical Specifications - "Surface Restoration."

**4.4 Additional Excavation**

All such additional excavating work shall be performed by Change Order, unless previously shown on the Drawings and/or called for in the Bid Schedule or identified in other portions of the Specifications. This provision applies also to manhole and vault foundations.

**4.5 Shoring, Sheet piling, and Bracing**

Unless provided for in the Bid Schedule, no additional payment will be made for shoring, sheet piling, or bracing of trenches.

END OF SECTION

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Attachments:

Test Worksheet for the Water Lines - Leakage Test

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### WATER LINES

#### PART 1 - GENERAL

##### 1.1 Scope

- A. These Specifications cover the furnishing and installation of potable water lines, valves, fittings, and related appurtenances. This work includes, unless otherwise specified, furnishing all labor, materials, tools, equipment, and incidentals required to construct a complete water line ready for service as outlined on the Drawings and in the Specifications.
- B. Requirements for excavation and backfill of trenches, surface restoration, traffic control, and special appurtenance, etc., are specified under other Technical Specifications, when applicable.
- C. Items specified in this Technical Specification are intended to be broad in scope and may not always apply to all items of Work to be constructed. All applicable sections, as determined by the Engineer, shall control the Work outlined in the Contract Documents.

##### 1.2 Specifications References

Specification references made herein for manufactured materials such as pipe, valves, and fittings refer to designations for the American Water Works Association (AWWA), American National Standards Institute, Inc. (ANSI) or to the American Society for Testing and Materials (ASTM) as they are effective on the date of call for Bids.

##### 1.3 Catalog Information

Catalog information on all equipment and materials to be installed shall be submitted to the Engineer for review prior to purchase and installation of the items.

##### 1.4 Interruption of Utility Service

See the "Existing Utilities" section of the General Requirements.

##### 1.5 Delivery, Storage, and Handling

- A. Adequate precautions shall be taken to prevent damage to piping and protective coatings. During transporting, pipe and other materials shall be secured individually by use of wood spacer blocks, wood crates, or otherwise protected to prevent collision of individual pieces and accompanying damage.

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- B. Where possible, all materials furnished by the Contractor shall be delivered and distributed at the Site by the Contractor so that each piece is unloaded opposite or near the place where it is to be placed in the trench.
- C. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. During freezing weather, valves shall be stored to prevent accumulation of water in housing which could freeze and damage valves. Under no circumstances shall materials dropped during handling be installed or be used in the Work.
- D. All pipes, valves, fittings, and all other materials used in the construction of the water lines shall be carefully inspected by the Contractor prior to installation. All defective materials shall be rejected.
- E. Proper materials, tools, and equipment shall be used by the Contractor to provide safe and convenient prosecution of the Work.

#### 1.6 Materials Furnished by Owner

*Not Used*

#### 1.7 Manufacturer's Certification

If requested to do so, the Contractor shall furnish to the Engineer a sworn statement from the product manufacturer, stating that inspection and all specified tests have been made on the supplied material and that the results thereof comply with all appropriate Specifications. The statement shall also state that all materials furnished are in accordance with these Contract Documents and that all materials are new.

### PART 2 - MATERIALS

#### 2.1 General

- A. The Contractor shall furnish and install water lines and valves of the size, type, class, and material called for on the Drawings, in the Bid Schedule and as specified. Where no specific type of pipe is called for, the Contractor may select any type listed herein. Once a particular type and manufacturer is selected, the Contractor shall use that type for the entire Project unless other types are specifically called for on the Drawings.

#### 2.2 Pipe

- A. PVC Pipe

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1. C900-16 Pipe

PVC pipe for water lines shall conform to AWWA C900-16, DR 41 (100 psi). The pipe shall have flexible rubber gasketed joints conforming to ASTM D3139 and ASTM F477. Pipe shall be JM Eagle, North American Pipe Corporation, or approved equal. Pipe color shall be blue.

2. IPS Pipe

Iron Pipe Size (IPS) pipe for water lines shall conform to ASTM D2241, SDR 41 (100 psi). The pipe shall have flexible rubber gasketed joints, except where solvent welds are specifically called for on the Drawings. Pipe shall be manufactured by JM Eagle, North American Pipe Corporation, or approved equal.

3. IPS Pipe for Turnout

PVC turnout, when required, shall conform to ASTM D2241 minimum Class 40 and shall be either solvent weld or restrained joint. Stainless steel inserts shall be installed at all compression fittings.

B. Ductile Iron Pipe

1. Ductile iron pipe and fittings shall conform to AWWA C150, AWWA C115, AWWA C151, AWWA C153, and AWWA C110 and shall be minimum pressure Class 350 unless specified otherwise.

2. All ductile iron pipe shall have a bituminous sealed cement mortar lining conforming to AWWA C104 on the interior.

3. All joints unless otherwise specified shall be push-on rubber gasket joints conforming to AWWA C111 and shall be furnished complete with all necessary accessories.

- a. Flanges for couplings and fittings shall conform to ANSI B16.1, 125-pound bolt hole template.
- b. Mechanical joints shall conform to AWWA C111.

4. Where called for on the Drawings, restrained pipe joints shall be bell and spigot ductile iron with field installed gaskets, such as the FIELDLOK™ Gasket System as manufactured by United States Pipe and Foundry Company, or approved equal.

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5. When flanged pipe is required, the Contractor shall provide the D.I. pipe class required by the flange manufacturer to ensure the pipe and flange units are compatible. These data shall be provided to the Engineer for review prior to ordering these materials.

C. High Density Polyethylene Pipe (HDPE)

HDPE pipe shall conform to AWWA C906 DR-32.5 (PE 4710) iron pipe size (IPS) for pipe diameters 4-inch or greater, or as called for on the Drawings. All joints shall be by the heat fusion method in accordance with the manufacturer's requirements. Fusion technicians who have been trained by the pipe manufacturer or by the fusion equipment manufacturer's representatives must conduct the butt fusion joining. Butt fusion shall be performed using suitable machinery approved by the pipe manufacturer. Fittings shall be standard commercial products manufactured by injection molding or by extrusion and machining or fabricated from AWWA C906 pipe or as called for on the Drawings. All fittings shall have the same pressure rating as the pipe unless otherwise specified on the Drawings. The Contractor shall provide detailed Shop Drawings for all joints and connections, including provisions for expansion and contraction as recommended by the pipe manufacturer.

D. Galvanized Pipe for Turnout, Airvents, Inlet and Outlet Couplers

Galvanized steel pipe, when required, shall conform to ASTM A120 and shall be schedule 40 or 10 gauge.

### 2.3 Fittings for Iron and PVC Pipe

A. General

1. Unless specified otherwise, all fittings such as elbows, tees, crosses, valves, etc., shall have mechanical joints conforming to AWWA C111 and shall be short-bodied compact ductile iron fittings conforming to AWWA C153, Class 350.
2. When called for, flanged cast iron fittings shall conform to AWWA C110 with ANSI B16.1, 125-pound bolt hole template.
3. All fittings shall be cement mortar lined in accordance with AWWA C104.
4. Gaskets shall be either ring or full faced, 1/8-inch thick conforming to AWWA C111, Appendix B.

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##### B. Restrained Pipe Joints and Fittings

###### 1. Restrained Push-on Joint Pipe

When restrained joint ductile iron pipe is required, the pipe shall be the same class and type as the ductile iron pipe specified herein. Joints shall be Tyton Joint with Field Lok 350 gaskets, or approved equal. The restraint shall be boltless, integral restraining system, rated for 350 psi in accordance with the performance requirements of ANSI/AWWA C111/A21.11.

###### 2. Restrained Fittings

All mechanical joint fittings called out to be restrained shall be equipped with a MEGALUG Series 1100 mechanical joint restraint system as manufactured by EBAA Iron, Inc., or approved equal.

##### C. Water Main Couplings

1. Water main couplings shall be fabricated steel "Dresser" style couplings, or approved equal, conforming to AWWA C219.

2. The Contractor shall provide the appropriate coupling and gaskets as required to match the water line types and sizes being utilized.

3. Couplings shall be rated for the working pressure of the pipe main for which they will be utilized.

#### 2.4 Valves

##### A. Gate Valves

1. Gate valves 2 inches and smaller shall be all bronze, non-rising stem, conforming to Manufacturers Standardization Society (MSS) SP-80, Class A rated for a minimum working pressure of 125 psi.

2. Gate valves 2-1/2-inch to 12-inch shall conform to AWWA C509 or C515. Valves shall be designed for 125 psi minimum working pressure and shall be of iron body, resilient wedge, non-rising stem construction. Valves shall be equipped with O-ring type packing. The valve shall have a 2-inch AWWA operating nut for buried service or as called for on the Drawings. The valve ends shall be of the type required to match the pipe to which they will be connected, or as shown on the Drawings. Valves shall have mechanical joint connections, unless called for



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otherwise on the Drawings. Valves shall be resilient wedge, Kennedy KSRW or KSFW, Ken-Seal II, M&H Style 4067 or 7000, Clow, or equal.

3. Gate valves 14-inch and 16-inch shall meet or exceed the requirements of AWWA C509 and shall also conform to the applicable requirements of AWWA C500. Valves shall be designed for 200 psi minimum working pressure and shall be of iron body, resilient wedge, non-rising stem construction. Valves shall be equipped with O-ring stem seal. The valve shall have a 2-inch AWWA operating nut. The valve ends shall be of the type required to match the pipe to which they will be connected or as shown on the Drawings. Valves shall be Metroseal 250 as manufactured by U.S. Pipe or approved equal.
4. Gate valves 18 inches and larger shall conform to AWWA C500. Valves shall be designed for 150 psi minimum working pressure and shall be of iron body, double disk, parallel seat, bronze mounted, non-rising stem construction. Valves shall be equipped with O-ring type packing. The valve shall have a 2-inch AWWA operating nut. The valve ends shall be of the type required to match the pipe to which they will be connected, or as shown on the Drawings. Valve shall be M&H NRS Style 67 or equal.

#### B. Ball Valves

Ball valves 2 inches and smaller shall be bronze, conforming to Federal Specifications MSS SP-72 and MSS SP-110 rated for a minimum working pressure of 125 psi.

#### C. Butterfly Valves

1. All butterfly valves shall be of the rubber-seated tight-closing type that shall meet or exceed the requirements of AWWA C504. All valves shall be M&H 4500, Clow 4500, Tuf-Skin Lug Style TNO, or approved equal.
2. The valve shall be for buried service with a sealed gear operator having 2-inch AWWA operating nut and shall open counter-clockwise.
3. The valve ends shall be of type required to match the pipe to which they will be connected as required in the Bid Schedule or as shown on the Drawings.

#### D. Concrete Valve Box

1. Each valve shall be equipped with concrete valve box with a steel lid.

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2. The diameter of the valve box shall be not less than 5 inches, and shall be of such length so as to provide the depth of cover over the pipe without full extension.

#### E. Canal Gates

1. All canal gates shall be Waterman C-10 Canal headgate or approved equal and as shown on the drawings.

#### **2.5 Fire Hydrants**

*Not Used*

#### **2.6 Combination Air Release Valves**

*Not Used*

#### **2.7 Service Saddles**

*Not Used*

#### **2.8 Corporation Stops**

*Not Used*

#### **2.9 Curb Stops**

*Not Used*

#### **2.10 Service Line Couplings**

*Not Used*

#### **2.11 Curb Stop Box**

*Not Used*

#### **2.12 Meter Setters**

*Not Used*

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##### 2.13 Water Meters

- A. All water meters for use on turnouts shall be instantaneous with readings in Gallons per Minute and totalizing with readings in Acre-ft. Shall be McCrometer McMag 2000, Seametrics AG90 or approved equal.

##### 2.14 Locating Wire

- A. Locating wire shall be a minimum of 12 awg UF solid copper with blue colored insulation. The use of THHN wire will not be acceptable. The silicone splice kit shall be King Technology Model 50-566 or approved equal.
- B. Where location wire is to be secured to the exterior of fire hydrants, valve boxes, posts, etc., stainless steel pipe straps shall be used.

##### 2.15 Thrust and Anchor Blocks and Concrete Collars

- A. Concrete used for thrust and anchor blocks, and concrete collars shall be Portland Cement concrete with a 28-day compressive strength of 2,500 psi. Concrete thrust blocks shall cure for 3 to 5 days before hydrostatic or leakage testing of pipelines unless otherwise approved by the Engineer.
- B. Anchor rods shall be 3/4-inch diameter galvanized steel or epoxy coated reinforcement bar conforming to AASHTO M 284, embedded a minimum of 18 inches in the concrete.

##### 2.16 Water Line Blowoff

*Not Used*

##### 2.17 Water Marker Post

4-inch x 4-inch pressure treated wood post or approved equal.

##### 2.18 Water Line Caution Sign

*Not Used*

##### 2.19 Tools

The Contractor shall supply to the Owner the following tools:

Five valve wrenches of proper length

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There will be no separate measurement and payment for these tools.

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

##### **3.1 Trench Excavation and Backfill**

Trench excavation and backfill shall be performed as specified in the Technical Specifications for "Excavation and Backfill of Trenches."

##### **3.2 Record Drawings**

The requirements for Record Drawings, etc., as required in the General Requirements shall be carefully complied with.

##### **3.3 Installation of Pipe**

- A. Water pipe shall be installed in accordance with best current practices as required by the manufacturer and as specified herein. PVC pipe installation shall conform to the Uni-Bell Plastic Pipe Association, "Guide for Installation of PVC Pressure Pipe for Municipal Water Main Distribution Systems" and also AWWA M23 "PVC Pipe - Design and Installation." Ductile iron pipe installation shall conform to the requirements of AWWA C600. HDPE pipe installation shall conform to the Plastics Pipe Institute, "Handbook of Polyethylene Pipe" and also AWWA M55 "PE Pipe – Design and Installations"
- B. Water pipe shall be installed with bell ends laid facing in the direction of laying unless directed otherwise by the Engineer. Each pipe shall be properly bedded so as to be supported for the full length of the pipe. A suitable foundation shall be achieved by a slight excavation under the bell at each joint. All rubber ring joints shall be lubricated and installed in accordance with the installation instructions of the pipe manufacturer, taking particular care to avoid pinching or otherwise causing damage to the rubber ring. All joints shall be free of dirt and other foreign matter prior to the joining of the next pipe. All joints shall be restrained to prevent creep and misalignment of joints.
- C. Water lines shall be installed to the minimum depths called for on the Drawings and to the lines and grades when shown.
  - 1. It shall be recognized that water line depths may vary from the minimum depths shown when adjustment of grade is required to avoid conflict with existing utilities.
  - 2. Additional fittings may also be required when a grade adjustment is required.

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- D. No pipe shall be installed in water or when conditions exist that, in the opinion of the Engineer, are unsuitable for the laying of the pipe.
  - 1. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other approved means. This provision applies during the noon hour as well as overnight.
  - 2. If there is water in the trench, the seal should remain in place until the trench is dewatered sufficiently to prevent groundwater from entering the pipe. Adequate provisions shall be made by the Contractor for final disposal of the groundwater pumped from trenches.
  
- E. All pipe shall be installed true to line. The Contractor may install a pipeline on a curve when called for on the Drawings or when approved by the Engineer.
  - 1. For rubber gasketed ductile iron pipe installed on a curve, the pipe shall be joined in a straight alignment, then deflected. The amount of deflection shall not exceed 80 percent of the recommended maximum deflection specified in AWWA C600.
  - 2. For HDPE and PVC pipe installed on a curve, deflection of the pipe shall be achieved by bending the pipe within the limitations specified by the pipe manufacturer. Joint deflection of PVC pipe is not allowed.

#### 3.4 Thrust and Anchor Blocks

- A. Thrust and anchor blocks shall be constructed as shown on the Drawings and placed at all changes in direction, all changes in the diameter of the pipe, all dead-ends, as specifically shown on the Drawings and as required by the Engineer.
  
- B. All thrust blocks shall be placed between the undisturbed ground and the fitting to be anchored. Plastic sheeting shall be used to provide a bonding barrier between the fittings and the concrete. The quantity of concrete and the area of bearing on the soil shall be as shown on the Drawings or as approved by the Engineer.
  
- C. All thrust blocks shall be placed so that the entire pipe and fitting joints will be accessible for repairs. Bolts for mechanical and flange fittings and fire hydrant weep holes shall not be covered with concrete. All bolts shall be accessible and removable without interference from the thrust block.

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- D. Thrust blocks may not be required where approved restraint joint pipe and fittings are utilized.
- E. Concrete thrust blocks shall cure for 3 to 5 days before hydrostatic or leakage testing of pipelines unless otherwise approved by the Engineer.
- F. No backfill of thrust blocks shall occur until the Work has been observed by the Project Representative.

#### 3.5 Locating Wire

- A. A continuous solid copper locating wire shall be placed along the top of all water pipe, including turnouts. This wire shall be secured to the top of the pipe at maximum 10-foot intervals using 6-inch strips of 2-inch wide duct tape. All splices shall be electrically continuous. At all splices the connecting ends of the wires shall be overlapped and tied. The ends shall be stripped and connected with a wire nut to ensure an electrical connection and made waterproof with an approved silicone splice kit. Access to terminal ends of the locating wire shall be made at all valve boxes, vaults, etc. The result of this installation shall be a continuous wire circuit electrically isolated from ground.
- B. The Contractor shall be responsible for testing continuity and for testing isolation from ground in the wire after all Work has been completed on the test section. The Contractor is advised to do intermediate testing on their own after backfilling operations and prior to surface restoration work to be sure continuity is maintained. If there is a break or defect in the wire, it shall be the Contractor's responsibility to locate and repair the defect.
- C. The continuity of the location wire shall be tested from one test load point to the next by use of a temporary wire laid between test points in-line with an ohmmeter. Resistance shall be measured with an approved ohmmeter that has been properly calibrated. The continuity of a test section will be accepted if the resistance of the test section does not exceed 5 ohms per 500 feet of location wire being tested. Isolation from ground shall be measured with a megohmmeter and shall be a minimum of 20 megohms for any section of location wire tested. The Engineer shall witness the acceptance test. The wire and installation shall be included in the water line bid item price. No separate payment shall be made.

#### 3.6 Service Connections

The Contractor shall connect turnout to new or existing water mains as shown on the Drawings. This Work includes the installation of a saddle and making the connection. The Work will

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include potholing to locate any existing pipeline or turnout as required so the service connection can be performed.

#### 3.7 Turnouts

- A. The installation of new turnout and the connecting of existing turnout shall be performed in accordance with the Drawings, manufacturer requirements, and as specified herein. Water turnouts shall be laid by placing the pipe on the trench bottom with sufficient slack to prevent pulling apart of the joints when the backfill is placed. Splices shall be kept to an absolute minimum.
- B. The locations of existing turnout as determined by the Owner are shown on the Drawings. The locations of turnouts shown on the Drawings are approximate and may vary from the locations shown. The Owner will assist the Contractor in locating turnouts; however, the primary responsibility for performing excavation work to locate existing lines will be the Contractor's.
- C. The Work includes potholing to locate any existing pipelines or turnout as may be required so the turnout can be installed. The Work also includes connecting to the existing turnout when required.
- D. When the Drawings indicate that existing turnout will be utilized, and if the Contractor encounters an existing service line which appears to be in poor or unserviceable condition, the Contractor shall promptly contact the Engineer. If the Engineer determines that a portion of the existing service line needs replacement, the Contractor shall install a new service line and shall be compensated under the appropriate bid item.

#### 3.8 Turnouts by Boring and Open Trench Methods

- A. It is the general intent to try and install turnouts under paved streets by boring where possible. A pneumatic boring tool or other approved method will be used to install service lines under all paved streets. There may be areas where it is not possible to bore due to ground conditions which interfere in the operation.
  - 1. Where requested by the Engineer, the Contractor shall attempt to bore under paved streets. In areas where it appears that boring will be difficult as determined by the Engineer and the Contractor, the turnouts shall be installed by the open trench method. The Contractor shall make two attempts, if required, to bore under paved streets. If the second attempt fails, the Contractor shall install the service line by the open trench method.

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2. If the Contractor encounters an obstacle and is unable to continue boring, they shall notify the Engineer or their representative prior to withdrawing the boring device so that accurate pay quantities may be determined for unsuccessful boring. The Contractor shall be compensated for the unsuccessful boring attempts on a linear foot basis as listed in the Bid.
  3. The Contractor shall be compensated on an each basis for bore setup whether or not the attempt is successful or unsuccessful. Bore setup shall include all equipment, labor, tools, etc., required to excavate and install boring tool.
- B. The Contractor shall take care to not damage other utilities which might exist in the area. Prior to boring, the Contractor shall pothole to locate existing utilities. "Blind-boring" is not allowed. Repairs for damage to other utilities shall be the responsibility of the Contractor.
- C. Turnout to be installed in areas not under asphalt streets may be installed by either open trenching or boring as the Contractor may elect. However, if the Contractor elects to install the service line by boring in these areas, the Contractor shall be compensated for the Work under the "Service Line by Open Trench Method" and shall not be paid for boring tool setup, unsuccessful boring, service line by boring method, or sod restoration, except for where sod restoration is actually performed. Refer to the Drawings for additional requirements. All turnout shall be thoroughly flushed before connecting to existing lines or meters.

#### 3.9 Valves and Valve Boxes

- A. Valves and valve boxes shall be installed as shown on the Drawings. All valves and valve boxes shall be set plumb. The valve box shall be centered over the valve operator and free of any obstruction which would prevent operation of the valve nut.
- B. If the bury depth of the valve is greater than 4-1/2 feet, a valve operator extension shall be provided to within 1 foot of finish grade. The extension shall be permanently attached to the valve operator and a self-centering device shall be provided near the top of the valve operator extension. The box cover shall be flush with the finished grade. A concrete collar, where required, shall be installed.

#### 3.10 Fire Hydrants

*Not Used*



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##### 3.11 Removal of Existing Fire Hydrants

*Not Used*

##### 3.12 Water Line Blowoffs

*Not Used*

##### 3.13 Connections to Existing Lines

- A. Information shown on the Drawings indicating the size, type, class, and location of existing lines and associated fittings has been obtained from Record Drawings and other records. It is expected that there may be some discrepancies and omissions in the information shown on the Drawings. Therefore, it shall be the responsibility of the Contractor to excavate and inspect existing water lines requiring a connection in order to determine the exact fittings needed.
- B. In connecting to existing lines, the Contractor may select the combination of fittings they wish to use if different than shown on the drawings, subject to approval of the Engineer. Approved fabricated steel couplings, repair bands, transition couplings, or tapping sleeves are among the options available to the Contractor. The Contractor shall submit to the Engineer information on the type of couplings they propose to use.
- C. The Contractor shall provide special attention in providing thrust restraint for fittings installed as part of a connection to an existing line, when such connection will be placed into service before normal cast-in-place thrust blocks can achieve required strength. In such cases thrust restrained joints, precast thrust blocks, etc., must be utilized to provide thrust restraint. Methods used by the Contractor shall be approved by the Engineer.

##### 3.14 Water Meter Installation

*Not Used*

##### 3.15 Water-Sewer Line Crossings

*Not Used*

##### 3.16 Capping Existing Water Mains and Services

*Not Used*

## TECHNICAL SPECIFICATIONS

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#### WATER LINES

##### 3.17 Abandoned Water Lines

- A. The existing water lines to be taken out of service are marked on the Drawings. These lines are to remain in service until the new lines are properly installed and tested, and water services have been connected. Approval from the Engineer shall be obtained before any line is abandoned.
- B. The existing lines shall then be abandoned and their actual location and abandoned designation recorded on all Record Drawings.
- C. Unless called for otherwise, the abandoned lines will remain in the ground. The ends of all pipes which are abandoned shall be plugged with concrete or other methods approved by the Engineer. There shall be no separate measurement and payment for this Work.

##### 3.18 Air Release Vent

Air release vents shall be installed as shown on the Drawings, and as required by the manufacturer.

##### 3.19 Other Installations

Installations of valves and valve boxes shall be in accordance with the manufacturer requirements and the Drawings.

##### 3.20 Removal and Salvage of Water Main Appurtenances, Fittings, and Other Items

- A. The Contractor shall remove all existing valves, and fittings as required to properly perform the Work, or as shown in the Drawings. All such materials shall be transported to an area designated by the Owner and stockpiled. Materials shall be removed and handled in such a manner which will prevent damage.
- B. All other existing valves not used in the new system or specified for removal will be removed by the Owner after the new system is in operation. Salvaged material shall remain the property of the Owner.
- C. The abandoned existing pipe is to remain in the ground, unless otherwise specified.

##### 3.21 Work with Existing Asbestos Cement (A/C) Pipe

*Not Used*

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##### 3.22 Repair of Unmarked Water Lines

- A. The specific location, pipe size, type and bury depth of every existing water main and service may not be known. Prior to construction, the Owner will mark the location of known water lines with paint.
- B. The Contractor shall perform appropriate exploratory work to locate utilities when they are known to exist but the specific location is unknown or not marked accurately.
- C. Contractor shall repair the water main or service coupling using materials approved by the Engineer.

##### 3.23 Water Marker Posts

The Contractor shall furnish and place marker posts at locations shown on the Drawings and as directed by the Engineer to mark the locations of certain valves and other appurtenances. Posts shall be set solidly in the ground.

##### 3.24 Water Line Caution Sign

*Not Used*

##### 3.25 Testing and Disinfection

- A. General

The Contractor shall furnish all necessary equipment and other apparatus, including gauges, necessary to properly perform the testing and disinfection of water lines as specified. Lines to be tested include mains and turnouts. Each section of the lines, before being tested and placed into service, shall be isolated and slowly filled with water. Air should be expelled from the line through vents or taps made at the high points. The Engineer shall have the option of requiring the use of their own gauges. Water mains shall be generally tested in sections between valves and as the Work progresses. The Contractor shall be responsible for determining the length, timing, and section of lines to be tested, unless otherwise noted. When appropriate, testing intermediate sections of long lines should be considered. The Contractor shall provide any temporary test heads, fittings, blocking, etc., as may be required to properly test any given water main section. The Contractor shall be responsible for locating and repairing any defects in the water mains which fail to pass the required test.

- B. Acceptance Test

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#### WATER LINES

The Contractor shall perform all preliminary testing required to determine that the lines to be tested are acceptable and comply with the requirements of this section of the Specifications. After the Contractor has determined that the lines will pass the required test, the Contractor shall arrange for an acceptance test to be witnessed by the Engineer's representative. The Contractor shall coordinate the timing of this acceptance test with the Engineer's representative. The lines will not be accepted until the acceptance test has been witnessed and documented as passing. Forms for performing the various tests are included at the end of this Technical Specification for use and reference by the Contractor.

#### C. Hydrostatic Testing of Pressure Lines

All lines shall be pressure tested at 1.5 times the actual working pressure, whichever is greater, for one hour, unless otherwise indicated on the drawings. Any cracked or defective pipe, joints, or fittings shall be removed and replaced.

#### D. Leakage Test

Each section of the line, after all backfill and compaction work has been completed and before being placed into service, shall be tested for leakage for a period of two hours at a minimum average gauge pressure of 1.5 times the actual working pressure. Leakage is defined as the quantity of water supplied into the section of line being tested, during and at the end of the test, that quantity being such that the pressure at the end of the test is equal to the pressure at the beginning of the test. Should any test disclose leakage greater than that specified, the Contractor shall locate and repair the defective joints until the leakage is within the specified allowance.

$$\text{PVC Pipe: } L = \frac{ND\sqrt{P}}{7,400} \quad \text{DI Pipe: } L = \frac{SD\sqrt{P}}{133,200}$$

In which:

- L = Allowable Leakage Gal/Hr
- S = Length of Pipe Tested in Ft.
- N = Number of Joints or Connections
- D = Nominal Diameter in Inches
- P = Gauge Pressure in psi

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#### WATER LINES

#### 3.26 Restoration, Finishing, and Cleanup

- A. The Contractor shall restore or replace all paved surfaces, graveled surfaces, curbing, sidewalks, trees, shrubbery, lawns, pastures, fences, and other existing facilities equal to their original condition.
- B. All surplus material and temporary structures as well as excess excavation shall be removed and the entire Site of Contractor operations shall be left in a neat and clean condition as outlined in the General Conditions.
- C. Also see Technical Specifications - "Excavation and Backfill of Trenches" and Technical Specifications - "Surface Restoration" for specific requirements.

#### PART 4 - MEASUREMENT AND PAYMENT

##### 4.1 Basis

See Technical Specifications - "Measurement and Payment" for a description of the basis of measurement and payment for Work performed under this Contract.

##### 4.2 Tools

There will be no direct payment for these tools; payment shall be included in other bid items.

##### 4.3 Grade Adjustments

Grade adjustments to accommodate existing utilities shall be considered a normal part of the Work and no additional payment will be made for this work when the general location of existing utilities is shown on the Drawings.

##### 4.4 Capping of Existing Water Mains and Services

There shall be no separate measurement and payment for capping existing water main and services.

END OF SECTION

**TEST WORKSHEET FOR THE  
WATER LINES - LEAKAGE TEST**

Project Name \_\_\_\_\_

Date \_\_\_\_\_ Job No. \_\_\_\_\_

Location of Test/Stationing \_\_\_\_\_

---

Hydrostatic Test

Test Pressure \_\_\_\_\_

Time Test Started \_\_\_\_\_

Time Test Completed \_\_\_\_\_

TOTAL TIME \_\_\_\_\_ minutes

Test Passed    Yes    No

Leakage Test (Min. Test Pressure 100 psi)

$$\text{PVC Pipe: } L = \frac{ND\sqrt{P}}{7,400} \qquad \text{DI Pipe: } L = \frac{SD\sqrt{P}}{133,200}$$

In which:

- L = Allowable Leakage Gal/Hr
- S = Length of Pipe Tested in Ft.
- N = Number of Joints or Connections
- D = Nominal Diameter in Inches
- P = Gauge Pressure in psi

Allowable Leakage

<u>Pipe Section</u>	<u>Nominal Diameter</u>	<u>Number of Joints or Connections</u>	<u>Length of Pipe</u>	<u>Allowable Leakage</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Total Allowable Leakage \_\_\_\_\_ gal/hr

Time Test Started \_\_\_\_\_

Total Leakage Measured \_\_\_\_\_ gal.

Time Test Completed \_\_\_\_\_

Total Leakage Measured/Gal= \_\_\_\_\_ gal/hr

TOTAL TIME \_\_\_\_\_ mins. \_\_\_\_\_ Time (hr.)

Test Passed  Yes  No

Contractor's Firm Name: \_\_\_\_\_

Contractor's Representative Signature \_\_\_\_\_

Engineer's Representative Signature \_\_\_\_\_

Note: See Technical Specifications for directions of use.

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# TECHNICAL SPECIFICATIONS

## SECTION 4

### SURFACE RESTORATION

#### PART 1 - GENERAL

##### 1.1 Scope

- A. The Contractor shall perform all Work and furnish all materials to restore the work area including any gravel, asphalt, concrete, lawn, fences, or any other surfaces or items damaged or disturbed by their construction operation. Surface restoration shall follow as closely as possible the backfill and compaction of excavations.
- B. Items specified in this Technical Specification are intended to be broad in scope and may not always apply to all items of Work to be constructed. All applicable sections, as determined by the Engineer, shall control the Work outlined in the Contract Documents.

##### 1.2 Submittals

- A. Hydroseed

The hydroseed mix shall be reviewed by the Engineer prior to application.

#### PART 2 - MATERIALS

##### 2.1 Base Rock

Base rock shall substantially conform to current Oregon Standard Specifications for Construction for base aggregate materials, or as otherwise approved by the Engineer. The intent is to specify a base rock which is suitable for use in the restoration of areas disturbed by the Contractor's Work. Base rock required shall generally be 1"-0, or 3/4"-0 unless otherwise specified or approved. The Contractor shall submit to the Engineer Samples of the base rock proposed for use on the Project.

##### 2.2 Asphalt Concrete

Asphalt concrete shall be an approved commercial mix generally conforming to the applicable provisions of the current Oregon Standard Specifications for Construction for asphalt concrete pavement. Unless approved otherwise, the gradation of the mix shall generally conform to a 1/2-inch dense mix. The Contractor shall submit for review by the Engineer data on the asphalt concrete mix to be used. Data shall include aggregates, gradation and tolerances, aggregate suitability, asphalt concrete, mix proportions and tolerances, etc.

# TECHNICAL SPECIFICATIONS

## SECTION 4

### SURFACE RESTORATION

#### 2.3 Surface Aggregate

- A. The surface aggregate shall be crushed stone, slag, or gravel meeting the following requirements:

Liquid Limit (AASHTO T 89) 35 Maximum

Plasticity Index (AASHTO T 90) 2 to 9 Maximum

Dust Ratio  $\frac{\% \text{ Passing No. 200}}{\% \text{ Passing No. 30}}$  2/3 Maximum

Grading Requirements (AASHTO T 11 and T 27)	
Sieve	Percent Passing
1"	100
3/4"	70-98
#4	36-60
#8	25-47
#30	12-31
#200	8-15

- B. At least 70 percent by weight of the particles retained on the #4 sieve shall have at least two fractured faces.

#### 2.4 Cold-Mix Asphalt Concrete

*Not Used*

#### 2.5 Portland Cement Concrete

- A. The Portland Cement concrete used for this Work shall be an approved commercial transit mix. The exact proportions of all the materials entering into the concrete shall be as established by an approved laboratory mix design and shall be changed only as directed by the Engineer or laboratory when necessary to obtain the specified strength, desired density, uniformity, or workability. Previously prepared mix designs will be allowed provided adequate test data is available to document the suitability of the mix and the Contractor can document that the same materials are being used.

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- B. The mix shall have a maximum water-cement ratio of 0.45, a minimum 28-day compressive strength of 4,000 psi, a minimum of 564 pounds of cement per cubic yard of mix, and an air content of 4 to 7 percent. The maximum allowable slump shall be 4 inches for all structures covered under this section of the Specifications.

#### 2.6 Seed

- A. Lawn Seed

Lawn seed shall be a blend typically used in the area and of the type to match existing lawn areas, and must be approved by the Owner prior to use.

- B. Pasture Seed

Pasture seed shall be a mixture of orchard grass, rye grass, and fescue, native to the area and must be approved by the Owner prior to use.

- C. Upland Seed

Upland seed shall be a blend typically used in the area to match existing native dryland species and as approved by BLM for use on BLM land. Seed shall be a mixture of blue wild rye, tufted hairgrass, California fescue, California oatgrass, common yarrow, winecup clarkia and mountain monardella.

#### 2.7 Fertilizer

Except for hydroseeding, inorganic fertilizer shall be commercially available 22-16-8 with 22 percent nitrogen, 16 percent available phosphoric acid, 8 percent soluble potash, and a minimum of 2 percent sulfur.

#### 2.8 Topsoil

Topsoil shall be native to the area and shall be approved by the Engineer prior to use.

Furnish topsoil containing no substance detrimental to the growth of plants, that is free of plants designated by the Oregon Department of Agriculture as Type "A" or Type "B" weeds, and that is free of quack grass or crabgrass species.

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Furnish topsoil that is from the fertile part of a soil profile, commonly referred to as the "A" horizon, typically ranging in depth from 3 inches to 12 inches below original ground surface. Do not take material for topsoil from a depth greater than 12 inches below original ground surface.

#### **2.9 Mulch**

All mulch shall be straw that has been air dried and seasoned before baling or loading. It shall be free of noxious weeds and other materials detrimental to grass growth.

#### **2.10 Sod**

- A. Sod shall be 100 percent Kentucky Blue Grass or other types as approved by the Owner.
- B. The sod shall be grown on agricultural land that is cultivated specifically for turf sod. The sod shall be free of weeds, diseases, nematodes, and insects. All sod shall be mature and not less than 10 months old. All sod shall be machine cut to a uniform thickness of 5/8-inch or more, excluding top growth and thatch.

#### **2.11 Soil Conditioners**

Soil conditioners shall be manufactured from composted sewage sludge, amended with organic and inorganic materials. They shall be as manufactured by EKO Systems, Inc. of Lewiston, Idaho, or equal.

#### **2.12 Erosion Control Matting**

Erosion control matting shall be seed and curlex blanket as supplied by American Excelsior Co., of Yakima, Washington, or approved equal.

#### **2.13 Hydroseed**

- A. The hydroseed shall be a specifically designed hydromulch consisting of cellulose fiber, fertilizers, seed, tackifier, etc.
- B. The hydromulch shall be specifically processed cellulose fiber containing no growth or germination inhibiting factors. It shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogenous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of cellulose fiber shall be marked by the manufacturer to show the air dry weight and content.

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### SURFACE RESTORATION

- C. The fertilizer shall be a complete plant food containing slow release nitrogen, phosphoric acid, and potash in the amounts of 16-16-16+1.5 FE. It shall be delivered in uniform composition and be dry and free flowing and delivered in the original unopened containers bearing the manufacturer's guaranteed analysis.
- D. The grass seed shall be certified, blue tagged, cleaned, and delivered in original unopened packages bearing an analysis of the contents. It shall be guaranteed 95 percent pure and have a minimum germination rate of 85 percent within 1 year of test. The seed shall be as agreed upon by the Owner. The seed shall be applied at a minimum rate of 4 pounds per 1,000 square feet.

#### 2.14 Slope Stabilization Rock

- A. Slope stabilization rock shall be pit run, a well-graded 4"-0 material with the approximate gradation:

Sieve	Percent Passing
4"	100
2"	35-50
1/2"	10-20
Less 1/4"	0-5

- B. The 4"-0 slope stabilization rock shall be hard, durable, and resistant to weathering. The rock shall be angular in shape with an apparent specific gravity of 2.5 minimum. The Contractor shall develop a test pile of 4"-0 slope stabilization rock for approval by the Engineer. Once the test pile has been approved by the Engineer, all other 4"-0 rock shall be visually the same as the test pile.

#### 2.15 Hot Asphalt-Rubber Joint Sealant

Hot asphalt-rubber joint sealant shall be Roadsaver 221 as manufactured by Crafc0, Inc., or equal.

### PART 3 - EXECUTION

#### 3.1 Gravel Surface Restoration

- A. During trench and general excavation, the Contractor shall minimize the disturbance of adjacent gravel surfaces.

## TECHNICAL SPECIFICATIONS

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#### SURFACE RESTORATION

- B. Backfill of trenches and other work areas shall be in accordance with Technical Specifications - "Excavation and Backfill of Trenches," or other applicable requirements.
- C. In gravel streets, parking areas or driveways disturbed by the Work, the Contractor shall resurface the areas with gravel aggregate or surface aggregate, as required on the Drawings.
- D. In gravel streets, shoulders, parking strips and driveways, a 4-inch minimum compacted depth shall be required or a compacted depth equal to the existing depth of gravel plus the depth of granular subbase, if any, whichever is greater, unless otherwise specified on the Drawings or in these Specifications.
- E. The resurfacing aggregate shall be compacted to 95 percent of laboratory density as determined by ASTM D1557.

#### **3.2 Asphalt Street Restoration and Asphalt Parking-Driveway Restoration**

- A. Existing asphalt surfaces shall be cut on each side of the trench prior to excavation to provide a vertical, neat, straight-line joint in the surface. Should any asphalt surface be undermined or damaged during construction, the undermined or damaged asphalt shall be similarly cut and removed prior to backfill. This work shall be performed along neat, continuously straight lines to provide a pleasing finished appearance. Irregular lines will not be allowed.
- B. Backfill shall be made in accordance with Technical Specifications - "Excavation and Backfill of Trenches."
- C. The base rock under the asphalt pavement shall be replaced to a compacted depth equal to the existing base rock depth plus the depth of granular subbase, if any, unless specified otherwise on the Drawings or in these Specifications. The base rock shall be compacted to 95 percent of the laboratory density as determined by ASTM D1557.
- D. Immediately following backfill and compaction of the trench, and until the asphalt concrete is replaced, the base rock course shall be placed and compacted flush with the existing asphalt surface and maintained in a good condition.
- E. In areas of heavy traffic, highway crossings, etc., a temporary cold-mix patch shall be placed and maintained until asphalt surface restoration is accomplished. The cold-mix asphalt concrete delivered to the Project shall be fresh and workable.
- F. Just prior to placing the asphalt concrete, the base rock course and any temporary patch shall be excavated to the depth equal to that of the asphalt concrete to be placed.

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##### G. Placement of Asphalt Concrete

1. Asphalt concrete for all areas, except in the State Highway, shall be 4 inches in depth after compaction or a depth equal to the existing pavement, whichever is greater, unless specified otherwise on the Drawings or in the Specifications.
2. Asphalt concrete shall be compacted with an 8-ton minimum steel-wheeled roller and compacted to a minimum of 91 percent of the maximum density as determined by ASTM D2041.
3. Prior to placing the asphalt concrete, an asphalt tack coat shall be applied to the edges of the existing asphalt. An asphalt tack coat shall also be used between lifts should the Contractor elect to patch with multiple lifts. The Contractor shall utilize a paving machine, spreader box, or other approved mechanical equipment to place the asphalt concrete material. No lift of asphalt placed shall have a compacted thickness of less than 1/2 inch or greater than 3 inches. The finished asphalt surface shall be flush with the existing surface, uniform in appearance equal to or better than the existing pavement, and shall provide a smooth ride.
4. Installation shall conform to the applicable provisions of the current Oregon Standard Specifications for Construction, Sections 00495 and 00744. Asphalt Concrete for temporary patches shall conform to Section 00745.50 of the Oregon Standard Specifications for Construction.

##### 3.3 Asphalt Concrete Joint Sealing

- A. After a minimum of 30 days following completion of asphalt concrete restoration, the Contractor shall rout and clean joints between new asphalt concrete and the existing pavement.
- B. Routed joints shall be 1/2-inch wide x 3/4-inch to 1-inch deep.
- C. A hot asphalt-rubber joint sealant shall be placed in the joint flush with the surface to make a watertight seal.

##### 3.4 Concrete Sidewalk and Curb Restoration

*Not used*

##### 3.5 General Surface Restoration

- A. General

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#### SURFACE RESTORATION

1. The Contractor shall replace or restore, equivalent to their original condition, all surfaces, trees and shrubbery, lawns, agricultural areas, pastures and fences, or other existing facilities disturbed by their Work unless otherwise specified. Restoration and cleanup shall be a continuing operation and shall be diligently pursued until completed. Surface restoration shall be completed as soon as possible after the underground work is complete.
  2. All surplus material, rock and debris, and temporary structures, as well as excess excavation, shall be removed by the Contractor and the entire Site of Contractor's operations shall be left in a neat and clean condition.
  3. Lawns and pastures in private easement shall be restored to a smooth condition and reseeded with a like mixture of grass unless specified otherwise on the Drawings, in the Specifications, or in the easement documents. When backfilling trenches in private easements, unless otherwise specified, Contractor shall replace topsoil to minimum 1-foot depth or to a depth equal to the original depth, whichever is less. Lawn sod shall be utilized where called for on the Drawings or where required by the Engineer.
- B. Agricultural Areas
1. Where called for on the Drawings, the existing top soils in the excavation area shall be removed and stockpiled at a separate location from the general trench excavation material. This topsoil shall not be mixed or contaminated with any other materials.
  2. Upon completion of the trench backfill and after all rocks and unsuitable material have been removed from the work area, the stockpiled topsoil shall be replaced and graded to match the existing ground. The depth of topsoil restoration shall be as shown on the Drawings.
- C. Upland Areas
1. 1. Where called for on the Drawings, the existing top soils in the excavation area shall be removed and stockpiled at a separate location from the general trench excavation material. This topsoil shall not be mixed or contaminated with any other materials.
  2. Upon completion of the trench backfill and after all rocks and unsuitable material have been removed from the work area, the stockpiled topsoil shall be replaced and graded to match the existing ground.



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#### D. Seeding

1. All areas to be seeded shall have a minimum of 6 inches of topsoil.
2. After the backfilling and compaction have been completed, the top 2 inches of the topsoil shall be scarified to provide a good seed bed and the area seeded, fertilized, compacted with a weighted roller, a straw mulch applied, and the initial watering completed.
3. All additional watering of the grass seed shall be the responsibility of the property owners.
4. BLM Requires 25Lb/Acre for upland seed mix. Unless required otherwise, the seed shall be applied at a minimum rate of 4 pounds per 1,000 square feet, the fertilizer at 1 pound per 100 square feet, and the mulch at a rate needed to provide a minimum mulch thickness of 1 inch.
5. An additional broadcast seeding of the upland seed mix shall occur in the Fall over the disturbed upland area and shall be the responsibility of the property owners.

### 3.6 Hydroseeding

#### A. Application Rates

Hydroseeding shall be placed at the following application rates unless otherwise shown on the Drawings or approved by the Engineer.

Material	Application Rate
Mulch	2,000 pounds per acre
Fertilizer	Lawn 430 pounds per acre Dryland Grass 50 pounds per acre
Tackifier	20 pounds per acre
Seed	4 pounds per 1,000 square feet
Wood Cellulose Fiber Tracer	< 250 pounds per acre

## TECHNICAL SPECIFICATIONS

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#### SURFACE RESTORATION

- B. Seeding shall not be done during windy weather or when the ground is excessively wet or otherwise un-tillable. Seed shall be placed at the rate and mix specified below. Seed will be placed with an approved hydroseeder which utilizes water as the carrying agent, and maintains continuous agitation through paddle blades.
- C. Hydroseeder
  - 1. Hydroseeder shall have an operating capacity sufficient to agitate, suspend and mix into a homogenous slurry, and the specified amount of seed and water or other material.
  - 2. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles which will provide a uniform distribution of the slurry.
- D. Seed and fertilizer may be applied in one application provided the fertilizer is placed in the hydroseeder tank no more than 30 minutes prior to application. The seed shall have a tracer added to aid uniform application. This tracer shall not be harmful to plant and animal life.
- E. The Contractor shall remove mulch material which falls on plants, roadways, gravel shoulders, structures, areas where mulching is not specified, or which collects at the ends of culverts or accumulates to excessive depths, as directed.

#### **3.7 Erosion Control Matting**

- A. Place matting as called for on the Drawings or as required by the Engineer. Prepare Site as specified for permanent seeding area preparation.
- B. Immediately following the establishment of the finished grade, matting shall be placed parallel to the flow of water. Where more than one strip of matting is required to cover the given area, it shall overlap the adjacent mat a minimum of 4 inches.
- C. The ends of the matting shall overlap at least 6 inches with the upgrade section on top. The upslope end of matting shall be staked and buried in a 6-inch deep trench with the soil firmly tamped against the mat. Three stakes per width of matting (one stake at each overlap) shall be driven below the finish ground line prior to backfilling of the trench. The Engineer may require that any other edge exposed to more than normal flow of water or strong prevailing winds be staked and buried in a similar manner.

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- D. The edges of matting shall be buried around the edges of catch basins and other structures. Matting must be spread evenly and smoothly and in contact with the soil at all points.
- E. Matting shall be held in place by approved wire staples, pins, spikes, or wooden stakes driven vertically into the soil. The matting shall be fastened at intervals not more than 3 feet apart in three rows for each strip of the matting, with one row along each edge and one row alternately spaced in the middle. All ends of the matting and check slots shall be fastened at 6-inch intervals across their width. Length of fastening devices shall be sufficient to securely anchor the matting against the soil and driven flush with the finished grade.

#### 3.8 Mulch

- A. Place mulch approximately 1-1/2 inches deep in a loose condition at a rate of 2 to 2.5 tons/acre. Place grass straw mulch so that it is loose enough for sunlight to penetrate and air to circulate; but dense enough to shade the ground, reduce water evaporation, and materially reduce soil erosion.
- B. Anchor using a crimping disc, an approved tackifier, or approved modified sheepsfoot roller, or another method approved by the Engineer.

#### 3.9 Cleanup

- A. Cleaning up shall be a continuing process from the start of the work to final acceptance of the Project. The Contractor shall, at all times, keep the area on which work is in progress free from accumulations of waste material or rubbish.
- B. Spillage from the Contractor's hauling vehicles on traveled public or private roads shall be promptly cleaned up. Upon completion of the work the Contractor shall remove all temporary structures, rubbish, and waste material, equipment and supplies, resulting from the Contractor's operations. The Contractor shall leave such lands in a neat and orderly condition which is at least as good as the condition in which the Contractor found them prior to the Contractor's operations. See specific conditions in the General Requirements.
- C. In roadways and traffic areas, the Contractor shall be responsible for maintaining a road surface suitable for travel by the public from the time of excavation until the road surface has been restored. Such work includes dust control, temporary patching, signing, grading, and filling of potholes on temporary street surfaces, etc. The

## **TECHNICAL SPECIFICATIONS**

### **SECTION 4**

#### **SURFACE RESTORATION**

Contractor shall be responsible for all Claims and damages resulting from their failure to maintain a suitable surface.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.1 Basis**

See Technical Specifications - "Measurement and Payment" for the description of the basis of measurement and payment for the Work performed under this Contract.

END OF SECTION

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# TECHNICAL SPECIFICATIONS

## SECTION 5

### REINFORCED CONCRETE

#### PART 1 - GENERAL

##### 1.1 Scope

This section covers the mixing, placing, finishing, curing, and repairing of reinforced concrete. Portland cement concrete shall be composed of cement, aggregates, water, admixtures, etc., as specified or approved. The required proportions shall be assembled, well mixed, transported, placed, consolidated, finished, and cured as hereinafter specified. Concrete shall be uniformly dense and sound, free from faults, cracks, voids, honeycomb, and other imperfections.

- A. Concrete shall conform to the requirements of these Specifications and to the latest issue of the "Code Requirements for Environmental Concrete Structures" (ACI 350), and "Standard Specification for Ready Mixed Concrete" (ASTM C94) except as modified below.
- B. The Specifications in this section are general in nature and, therefore, some of the items outlined may not apply to the Work required. All applicable sections, as determined by the Engineer, shall control the Work outlined in the Contract Documents.

##### 1.2 Delivery, Handling, and Storage

- A. All cement shall be stored in a suitable, weather-tight building in such a manner as to protect the cement from dampness and to permit easy access for proper inspection. Storage bins for bulk cement shall be weather-tight and constructed so that there will be no dead storage. If there is reason to believe that dead storage exists, the bins shall be emptied completely at least every four months.
- B. Fine and coarse aggregates shall be stored and measured separately. Aggregates shall be protected from contamination with dust, dirt or other foreign materials.
- C. Steel reinforcement not placed in the Work shall be stored under cover to prevent rusting, and shall be placed on blocking such that no steel touches any ground surface.

##### 1.3 Submittals

- A. Reinforcing Steel
  - 1. Before ordering reinforcing steel, the Contractor shall submit all order lists and bending diagrams for review by the Engineer.

# TECHNICAL SPECIFICATIONS

## SECTION 5

### REINFORCED CONCRETE

2. Review of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of the responsibility for correctness of such lists and diagrams.
3. Any expense incidental to the revision of materials furnished according to such lists and diagrams to make the material comply with the Drawings shall be borne by the Contractor.

#### PART 2 - MATERIALS

##### 2.1 Portland Cement

Portland cement shall conform to the requirements of ASTM C150, for Type I - II cement. The Engineer may direct the use of Portland cement of a type other than that specified in the Contract Documents, in which case the Owner will pay the additional cost, if any, for the cement required over the cost of that specified, or shall receive appropriate credit for any cement required of a lesser cost than that specified.

##### 2.2 Aggregates

###### A. General

1. All aggregates for concrete shall conform to the Specification for "Concrete Aggregates" (ASTM C33). No aggregate shall be incorporated into the Work until and unless the aggregates are approved by the Engineer.
2. The decision to perform any or all tests on aggregates shall be left to the Engineer. Should testing of the aggregates be deemed necessary, Samples shall be selected at random from the stockpile and tested for conformance with the Specifications.
3. When the aggregates have been approved by the Engineer, the source shall not be changed without the written approval of the Engineer.

###### B. Fine Aggregate

Fine aggregate shall consist of natural sand, having hard, strong, and durable particles and which does not contain more than 2 percent by weight of such deleterious substances as clay lumps, shale, schist, alkali, mica coated grains, or soft and flaky particles. The grading of fine aggregate shall range uniformly from coarse to fine within the limits specified in ASTM C33.

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#### C. Coarse Aggregate

1. Coarse aggregate shall consist of clean, hard, fine grained, sound crushed rock, or washed gravel which does not contain in excess of 5 percent by weight of flat, chip-like, thin, elongated, friable or laminated pieces, or more than 2 percent by weight of shale or cherty material.
2. Any piece having a major dimension in excess of 2-1/2 times the average thickness shall be considered to be flat and/or elongated.
3. The maximum size of coarse aggregate shall not exceed 1-1/2 inches, nor 1/5 of the narrowest dimension between the forms, nor 3/4 of the clear spacing between reinforcing bars.
4. The minimum size of coarse aggregate shall be 3/4-inch unless approved otherwise.
5. Coarse aggregate shall be uniformly graded from coarse to fine within the limits specified in ASTM C33.

#### 2.3 Water

Water for mixing shall be clean, fresh, and free from injurious amounts of oil, acid, chlorides, sulfates, alkali, organic matter, or other deleterious substances.

#### 2.4 Concrete Admixtures

##### A. General

1. The use of admixtures will be allowed only when included in the mix design or as specified.
2. Admixtures used will be considered as a means of improving workability and/or placement of the concrete.
3. Admixtures shall conform to the following:

Parameter	Reference
Air-entraining	ASTM C260
Water Reducer	ASTM C494, Type A
Set Retarding	ASTM C494, Type B



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Water Reducing/Set Retarding	ASTM C494, Type D
High Range Water Reducing (Super Plasticizer)	ASTM C494, Type F and G
Pozzolanic	ASTM C618, Type F

4. Admixtures shall be non-toxic after 30 days and shall contain no chlorides. Calcium chloride will not be permitted to be used in concrete.

#### B. Air-Entraining Admixtures

Provide air-entraining admixture in all concrete. Furnish manufacturer's compliance statement for these requirements.

#### C. Water Reducing Admixture

1. When water-reducing and/or super plasticizer admixtures are used, with the agreement of the Engineer, it shall be compatible with the air-entraining admixtures.
2. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
3. Furnish a compliance statement that the admixture used satisfies all requirements of this Specification.

## 2.5 Proportioning of Concrete Mix

#### A. General

The exact proportions of all materials entering into the concrete shall be as established by an approved laboratory mix design and shall be changed only as directed by the Engineer or Laboratory when necessary to obtain specified strength or desired density, uniformity, and workability. This requirement may be waived when adequate test data is available on mixes currently being used to verify the suitability of a given mix for the job, or as approved by the Engineer.

#### B. Mix Design

1. The mix shall meet the following requirements unless otherwise specified or approved:

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Parameter	Class A	Class B	Class C
Minimum compressive strength (at 28-day test)	4,000 psi	3,000 psi	2,500 psi
Maximum water-cement ratio (by weight)	0.45	0.45	0.48
Minimum cement content (per cubic yard of concrete)	630 lbs	564 lbs	517 lbs
Air Content Range	4-7%	4-7%	4-7%

2. All classes of concrete shall have a maximum water soluble chloride ion content of 0.06 percent of mix design cement weight.
3. If the class of mix for the Work is not specified in the Contract Documents, then the mix shall meet the requirements of Class A.
4. Cement content specified above may be waived if sufficient evidence can be shown to the Engineer, such as previous test results, experience with water reducing admixtures, etc., to show that a lower cement content will give the desired 28-day strength.
5. Water Content and Slump Test
  - a. In calculating the total water content in any mix, the amount of free moisture (excess of saturated surface dry) carried on the surface of the aggregate particles shall be included. The amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity, and workability.
  - b. For the type of construction indicated, the slump shall be within the range indicated below unless approved otherwise:

Allowable Slump		
Location/Type of Construction	Slump in Inches <sup>(1)</sup>	
	Maximum	Minimum
Reinforced foundation walls and footings	4	2
Unreinforced footings and substructure walls	3	1
Reinforced slabs, beams and walls	4	2
Building columns	4	3

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Sidewalks, driveways, and slabs on ground	4	2
Heavy mass construction	2	1
Light weight concrete	3	1

<sup>(1)</sup>Slump listed in the table is the maximum slump allowed prior to the addition of water reducing or high range water reducing admixtures. Maximum allowable slump after the addition of admixtures is 8 inches.

#### 2.6 Reinforcing Steel

##### A. Steel Bars

Steel reinforcing bars shall be grade 60 billet steel, unless otherwise specified and shall conform to ASTM A615. Bars shall be deformed in accordance with ASTM A305. When called for on the Drawings, epoxy coated reinforcing bars shall conform to ASTM A775.

##### B. Welded Wire Fabric

Welded wire fabric, when called for on the Drawings, shall conform to ASTM A185.

#### 2.7 Grout

##### A. Nonshrink Grout

1. Grout shall be fluid grout capable of satisfactorily meeting the baseplate test and shall be non-metallic, unless specified for special use hereinafter. The grout shall be a non-gas-liberating type, cement base product, premixed, requiring only the addition of water for the required consistency. All components shall be inorganic.
2. The grout product shall satisfy all of the above requirements even though the Project use calls for a dry pack consistency and use.
3. The following listed grouts meet these requirements and are acceptable for use: UPCON High Flow, the UPCO Company, Cleveland, Ohio; Master Flow 713, The Master Builders Co., Cleveland, Ohio; or approved equal. Grout type and procedure shall be as recommended by the manufacturer for the specific application.
4. The grout used shall be cured with a curing compound sprayed on, or as recommended by the grout manufacturer.

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B. Neat Cement Grout for Horizontal Construction Joints

Grout for horizontal construction joints in walls and columns shall be flowable and shall consist of concrete sand, water, and a maximum water:cement ratio of 0.5. Proportions by weight: Two parts cement, three parts sand, and one part water.

C. Dry Pack Grout

Ordinary-type grout (Dry Pack) shall be one part Portland Cement to two parts clean concrete sand and sufficient moisture to permit packing and shaping. "Bond-Crete," or approved equal, shall be mixed with the water according to manufacturer's specifications.

D. Grout for Topping Concrete Slabs

Grout for topping concrete slabs shall conform to the following:

1. Proportions by weight: one part cement, two parts dry concrete sand, three parts aggregate (3/8-inch maximum size), and water as necessary.
2. The grout shall be cured with a curing compound sprayed on.

#### 2.8 Concrete Bonding Agent/Admixture

For bonding new concrete to old and as an admixture for concrete finish work, use Burke Acrylic Bond-Crete or equal.

#### 2.9 Curing Compounds

- A. Curing compounds shall conform to the requirements of ACI 308 and ASTM C309 and shall be compatible with required finishes and/or coatings.
- B. The compound shall be approved Type 2, Class B white or gray pigmented or Type 1-D clear compound with fugitive dye.
- C. Manufacturer's literature shall state quantity or coverage required to meet or exceed tests and method of application.

#### 2.10 Bond Breaker

Bond breaker shall be Burke Super Bond Breaker or equal.

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#### 2.11 Surface Hardener

Surface hardener shall be Saniseal as manufactured by Master Builders, or approved equal. Surface hardener shall result in a deposit of a hard, wear-resistant compound in the pores of the wearing surface to reduce absorption and arrest dusting.

#### 2.12 Mortar for Sack Rubbing

Mortar for sack rubbing shall consist of one part cement, two parts mortar sand by volume, a concrete bonding admixture, and enough water to obtain a mortar consistency of thick cream. The sand shall pass a No. 40 screen.

#### 2.13 Construction, Contraction, and Expansion Joints

Construction, contraction, and expansion joints are as follows or as approved by the Engineer:

A. Pre-molded Joint Filler for Expansion Joints

Bituminous type conforming to ASTM D994 or D1751, unless otherwise shown or specified.

B. Pourable Joint Fillers

1. Rubber Asphalt Filler: The specific gravity of the in-place filler after curing shall be greater than 1.0. Filler shall be No. 164.
2. Polymeric sealing compound, hot pour, or Hi-Spec Polymeric joint sealing, hot pour compound, as manufactured by W. R. Meadows, Inc., Elgin, IL; or No-Track two-component materials (Code 2323), cold applied, self-leveling filler as manufactured by A. C. Horn, Inc., North Bergen, NJ; or Gardox, two-component, cold applied compound filler, as manufactured by W. R. Meadows, Elgin, IL.
3. On sloping joints, use Gun Grade material of the above products or similar non-sag material; submit product information for approval.

C. Roofing Felt for Expansion Joints

Thirty-pound asphalt-saturated roofing felt conforming to ASTM D226, Type II; or a tar-saturated roofing felt of equal quality at the option of the Contractor.

#### 2.14 Waterstops and Sealants

A. PVC Waterstop

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1. Center bulb type, as shown on Drawings, extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinyl chloride (PVC). The size shall be as shown. Specific gravity shall be approximately 1.37 and the shore durometer Type A hardness, approximately 80. No reclaimed PVC shall be used in the compound.
  2. Waterstop shall have a constant thickness from the edge of the bulb to the outside edge. All waterstops shall have a number of parallel ribs or protrusion on each side of the center of the strip. Corrugated type waterstops are not acceptable.
  3. The minimum weight per foot for waterstop shall be 0.90 pound for 3/16-inch x 6-inch, 1.62 pounds for 3/8-inch x 6-inch, and 2.30 pounds for 3/8-inch x 9-inch.
  4. Certain approved manufacturers and Suppliers are listed below. Other products shall not be used without prior agreement by the Engineer.
    - a. Greenstreak Plastic Products
    - b. Vinylex Corporation
    - c. Vulcan Metal Products, Inc.
- B. Surface-Applied Waterstop
- Surface-applied waterstop shall be Adeka Ultraseal® KBA-1510 FP, Volclay Waterstop-RX® 102 or approved equal.
- C. Hydrophilic Caulk
- Hydrophilic caulk shall be Adeka P-201 caulking, or approved equal.
- D. Synthetic Rubber Sealant
1. Sealant for concrete structures shall be synthetic rubber sealing compound (polyurethane) as manufactured by Polymeric Systems, Inc., PSI 270 or PSI 270 SL; Pacific Polymers, Garden Grove, CA, Elastothane 227R, or equal.
  2. The material shall be multi-part polyurethane designed for continuous submerged condition in water or sewage and exposed to direct sunlight in dry condition. A compound shall be provided to cure at room temperature to firm, highly resilient rubber, and shall comply with FS TT-S-00227e, Type I, pourable grade, and Type II, non-sag, Class A, having the following properties determined at 75°F and 50 percent humidity:

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### REINFORCED CONCRETE

Property	Test Method	Value
Solids	---	> 97 percent
Application Time	---	> 2 hours
Cure Time	---	< 3 days
Tack Free	---	24 hours
Ultimate Hardness	Shore A	35 ± 5
Tensile Strength	ASTM D412	300 psi min.
Ultimate Elongation	ASTM D412	> 550 percent
Tear Resistance	ASTM D624 Die C	> 85 lbs/in.

3. Color and temperature service range: Gray to match concrete, unless otherwise indicated on the Drawings. Temperature service range: 50 to 200°F.

### PART 3 - EXECUTION

#### 3.1 General

All manufactured articles, materials, and equipment specified in this section shall be applied, installed, connected, erected, used, cleaned, and conditioned as recommended by the manufacturer and approved by the Engineer.

#### 3.2 Forming

##### A. General

1. The Contractor shall be responsible for the design, engineering and construction of formwork. Formwork shall conform to applicable requirements of "Recommended Practices for Concrete Formwork" (ACI 347).
2. Forms shall be used, whenever necessary, to confine the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. Forms may be of wood, metal or other material, and shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines.
3. The surface of all forms in contact with the concrete shall be smoothly finished and free from defects that might adversely affect the appearance of concrete formed against it.

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### SECTION 5

#### REINFORCED CONCRETE

4. All forms, whether prefabricated or custom made, shall be assembled and connected in such a manner that only minor mortar seepage through the joints will occur during vibration of the concrete.
- B. Form Surface Preparation
1. All dirt, chips, sawdust, mud, water, and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused.
  2. All wood surfaces in contact with the concrete shall be coated with an effective release agent prior to form installation. The release agent shall be non-staining and non-toxic after 30 days.
  3. Mill scale, rust, and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface of steel forms. All steel forms shall have the contact surfaces coated with a release agent. The release agent shall be effective in preventing discoloration of the concrete from rust, and shall be non-toxic after 30 days.
  4. Proprietary panels shall be free of surface cracks, spalls, gouging, splitting or other surface damage. Patching of forms is not acceptable. Any repairs must include complete surface recondition.
- C. Beveled Edges and Corners (Chamfers and Fillets)
1. Exposed sharp edges shall be eliminated from finished concrete work by means of 3/4-inch triangular fillets or chamfer strips placed in the forms.
  2. Where called for on the Drawings, horizontal corners shall be tooled with a 1/2-inch radius tool.
- D. Form Removal
1. All forms shall be removed before backfilling is begun.
  2. Forms shall be so constructed that they can be removed without hammering on or prying against the concrete and shall be removed in such a manner as to prevent damage to the concrete and to ensure the complete safety of all parts of the structure.



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3. The Contractor shall determine the time of removal of forms and shall be responsible for any damages due to early or improper form removal. In general the following periods, exclusive of days when the temperature is below 40°F, for removal of forms may be used as a guide.

Time Period for Removal of Forms	
Location	Time Period
Support Under Beams	14 days
Supported Floor Slabs	14 days
Walls	24 hours
Columns	7 days
Side of Beams and Other Parts	24 hours

### 3.3 Placement of Reinforcement Steel

#### A. General

1. Mild steel reinforcing bars shall be furnished, cut, cold bent, tagged, marked, shipped, and placed as indicated on Drawings and in accordance with the current edition of the "Manual of Standard Practice" by the Concrete Reinforcing Steel Institute. Field bending or straightening shall be accomplished so that the steel will not be damaged. Kinked bars shall not be used.
2. Reinforcing bars shall be in position before concrete placement is begun. All reinforcing bars shall be tied together and supported in such a manner that displacement during placing of concrete will not occur. Conform to the requirements of "Placing Reinforcing Bars" published by the Concrete Reinforcing Steel Institute.

#### B. Minimum Bar Spacing

The clear distance between parallel bars shall not be less than 1.5 times the nominal diameter for round bars, but in no case shall the clear distance be less than 1-1/2 inches nor less than 1.33 times the maximum size aggregate.

#### C. Concrete Cover

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1. At the time of placing concrete, all reinforcement shall be free from dirt, loose mill scale, detrimental rust, grease, oil, paint, or other foreign substances which might destroy or reduce its bond with concrete.
  2. Unless stated otherwise on the Drawings, the following minimum concrete cover over reinforcement steel shall apply.
    - a. All formed surfaces exposed to water, ground, or weather shall have a minimum cover over the reinforcement steel of 2 inches.
    - b. All surfaces cast against and permanently exposed to earth shall have a minimum cover over the steel of 3 inches.
- D. Splicing
1. Splices at the points of maximum stress shall be avoided.
  2. Bars in horizontal members shall have a minimum lap at splices sufficient to develop the strength of the bars. Whenever possible, splices of adjacent bars shall be staggered.
  3. In circular tank walls, the location of splices in the horizontal ring tension reinforcing bars shall be staggered a distance of two times the splice length or three feet whichever is greater, and splices shall not coincide in vertical arrays more frequently than every third bar.
  4. Deformed bars shall be lapped the minimum splice length as listed in the table below, or as shown on the Drawings, whichever is greater.
  5. Furnish full length reinforcing bars the specified length or the calculated length, and for those designated "full length."
  6. Splice bars with designated splice locations at those locations or fabricate bars full length.
  7. In absence of other directions, including bars designated "continuous," furnish reinforcing bars to provide the minimum practical number of bars and splices. In lapped splices, place bars in contact and fastened together with at least three ties.

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Reinforcing Bar Splice Length Table										
for 4,000 psi Concrete and Grade 60 Non-Coated <sup>1</sup> Reinforcing Bars										
Bar Size (No.)		3	4	5	6	7	8	9	10	11
Bar Orientation	Vertical and Horizontal	1'-7"	2'-1"	2'-7"	3'-1"	4'-6"	5'-2"	5'-10"	6'-7"	7'-3"
	Horizontal Top Bars	2'-1"	2'-9"	3'-5"	4'-1"	5'-11"	6'-9"	7'-7"	8'-6"	9'-6"

<sup>1</sup>For epoxy coated bars, increase the listed splice lengths by 50 percent.

#### E. Supports and Ties

1. All reinforcement shall be retained in place, true to indicated lines and grades, by the use of approved galvanized metal or concrete supports, spacers, or ties. They must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete.
2. Concrete blocks used to support reinforcement shall have a compressive strength of not less than the specified 28-day compressive strength of the concrete being placed. Rocks, clay bricks, masonry blocks, etc., or parts thereof, shall not be used to support reinforcement.
3. Tie bars in the top mats of footings and slabs at all intersections. Tie all other bars at all intersections except where spacing of the bars is less than 12 inches in each direction, then alternate intersections shall be tied.
4. Tie coated reinforcement with nonmetallic coated ties. Precast concrete blocks that support coated reinforcement shall have nonmetallic ties.

#### F. Reinforcement Around Opening

Where reinforcing steel has to be cut to permit passage of pipe or openings and should no detail be shown for extra reinforcing in such areas, at least an equivalent area of steel cut must be placed around all four sides of pipe or opening. This steel shall be extended at least 2'-0" beyond opening.

#### G. Inspection

The Engineer shall be notified when the reinforcing is ready for review with sufficient time for this review to occur prior to placement of the concrete.

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#### 3.4 Mixing

##### A. Batch Plant

1. Adequate equipment and facilities shall be provided for accurate control and measurement of all materials within specified proportions and tolerances, and for readily changing the proportions of materials as may be necessary to meet varying conditions of the Work in order to produce concrete of the required strength, durability and workability.
2. Batch plant equipment shall be in complete working order and equipment shall conform to the requirements of Section 00540.20 of Oregon Standard Specifications for Construction, current edition.

##### B. Mixers

##### 1. General

- a. Concrete shall be mixed in batch plant mixers or in a revolving drum type truck mixer.
- b. Concrete mixed in a batch plant mixer shall be hauled to the Project Site in a truck mixer.
- c. Mixers shall be equipped with a metal plate on which the manufacturer has marked the mixing and agitation speeds of the drum and the maximum mixing capacity.

##### 2. Batch Plant Mixing

Refer to Specifications for truck mixing.

##### 3. Truck Mixing

- a. Truck mixers shall be the revolving drum type, watertight, and constructed and maintained within tolerances of the manufacturer's specifications. Truck mixers shall be equipped and operated with a tank for carrying mixing water, a device to measure mixing water added to the mix and a device to indicate the number of drum revolutions.
- b. Before placing materials for the concrete into the mixer, empty the drum of water and reset the drum revolution counter to zero or record the

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counter number on the batch ticket. The total revolution on any load shall not exceed 300. The concrete in the truck mixer shall not exceed the manufacturer's maximum rated capacity. All materials of a batch shall be simultaneously and continuously fed into the mixer.

- c. Mixing shall commence as soon as the cement is added to the aggregate. Continue mixing before leaving the plant for not less than 70 nor more than 100 revolutions of the drum at the manufacturer's rated mixing speed. If water or additives are added to the batch at the Project Site, the concrete shall be mixed an additional 40 revolutions or more at the manufacturer's mixing speed, but the total revolution shall not exceed 300.
- d. All mixers, when fully loaded, shall mix the ingredients into a uniform mass within the required time. Only truck mixers that properly mix the concrete and are capable of discharging the concrete at a steady rate shall be used on the Project Site.
- e. During transport of the concrete, the truck mixer shall turn continuously at the rated agitation speed.

#### 3.5 Placing Concrete

##### A. Conveyance

- 1. Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position.
- 2. There shall be no free vertical drop greater than 6 feet, except when starting a vertical pour in which case the free vertical drop of concrete shall not be more than 2 feet.
- 3. In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs.

##### B. Placement

- 1. Concrete shall be placed before initial set has occurred and unless otherwise authorized by the Engineer, before it has contained its water content for more than 1-1/2 hours at 85°F. This time period may be extended provided Contractor can satisfy the Engineer that admixtures in sufficient quantity can extend the

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setting time of the concrete without adverse effects to the strength and quality of the concrete.

2. Unless otherwise specified, all concrete shall be placed upon clean, damp surfaces free from running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved tamping or other compaction so that ultimate settlement has occurred.
  3. Concrete shall not be placed in water nor shall water be allowed to rise over freshly placed concrete until the concrete has set sufficiently to prevent damage unless otherwise approved by the Engineer.
  4. Concrete shall not be placed until all reinforcement is securely and properly fastened in its correct position, and until the form ties at construction joints have been retightened, all sleeves, hangers, pipe, bolts, waterstop, and any other items required to be embedded in the concrete have been placed and anchored.
  5. Concrete shall be placed generally in horizontal layers not more than 12 inches thick except as otherwise specified. When a monolithic layer cannot be completed in one operation, it shall be terminated with a vertical bulkhead. Feathering out to less than 6 inches will not be permitted.
  6. All top surfaces not covered by forms, and which are to be covered by additional concrete or backfill, shall be carried slightly above grade, struck off and given specified finish.
- C. Vibration
1. Concrete shall be placed with the aid of approved mechanical vibrating equipment. Vibration shall be transmitted directly to the concrete; in no case shall it be transmitted through the forms. Vibrators shall be applied at uniformly spaced points not farther apart than the visible effectiveness of the machine.
  2. The vibrator shall at all times be inserted through the newly placed layer into the next lower course, to ensure a proper integration of one course to another, and shall then be pulled up slowly, the speed of which is dependent upon mix design and type of vibrator. The vibrator operator shall vibrate the concrete systematically from one point to another without skipping any areas or without having to move backwards and forwards in any one single pass. Particular care to vibrating concrete shall be given at horizontal and vertical construction joints to eliminate any possibility of honeycomb. Extreme care shall be exercised in using

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vibrators around waterstops to avoid damage to the waterstop. Every effort shall be made to avoid any contact of vibrator to reinforcing steel. At all times, the intensity and duration of vibration shall be sufficient to accomplish thorough and uniform compaction.

3. Vibrators shall not be used to flow or transport concrete inside of forms. Where necessary, vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces in order to secure smooth, dense, even surfaces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.
4. Only high frequency internal vibrators with operating speeds of preferably 21,000 vpm but not less than 14,000 vpm shall be used unless otherwise approved in writing by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to the proper degree within 5 minutes after it is deposited. The number of vibrators will be predicated by the nature of the job and the ability to sufficiently consolidate the concrete within the specified time.

#### 3.6 Restrictions Due to Weather

##### A. Cold Weather

1. Concrete placement in cold weather, i.e., 40°F or less, will be permitted only under conditions which shall meet the approval of the Engineer.
2. In general, cold weather placing shall conform to "Recommended Practice for Cold Weather Concreting" (ACI 306).
3. Salts, chemicals, or other foreign materials shall not be mixed with the concrete to prevent freezing, unless such use is authorized by the Engineer in writing.
4. All concrete shall be effectively protected from frost action for a period of 5 days after placing, during which the temperature of the concrete does not fall below 40°F. Upon written notice from the Engineer, all concrete which may have become damaged by frost action shall be replaced by the Contractor at their own expense.

##### B. Hot Weather

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1. For concrete placed during extremely hot weather (air temperature exceeding 95°F), the aggregate shall be cooled by frequent spraying in such a manner as to utilize the cooling effect of evaporation. During such periods, the placement schedule shall be arranged, as approved, in such a manner as to provide time for the temperature of the previously placed concrete to begin to recede.
  2. The mixing water shall be the coolest available at the Site insofar as is practicable. At no time shall the temperature of the concrete mix exceed 90°F prior to placement.
- C. Low Humidity
1. Placing of concrete during periods of low humidity (below 50 percent) should be avoided when feasible and economically possible, particularly when large surface areas need to be finished.
  2. In any event, finished surfaces exposed to the drying wind shall be covered up immediately with polyethylene sheets and be water cured continuously as soon as the concrete has set up.
  3. Curing compounds, in lieu of water, may not be used.

#### 3.7 Bonding Concrete

- A. Bonding to New Concrete
1. Roughen the surface of the hardened concrete. Thoroughly clean and saturate with water and apply a concrete bonding agent.
  2. Cover the horizontal surfaces with at least a 12-inch lift of superplasticized concrete (6-inch to 8-inch slump) and thoroughly vibrate the mix.
  3. New concrete is defined as less than 60 days old.
- B. Bonding to Old Concrete
1. Mechanically roughen the existing concrete surfaces to 1/4-inch amplitude using chipping guns or bushhammers, thoroughly clean, and then coat the contact surfaces with a concrete bonding agent.



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2. The method of preparation and application of the bonding agent shall conform to the manufacturer's printed instructions and recommendations for specific application for this Project.
3. Obtain this recommendation in writing from the manufacturer's representative.
4. Cover horizontal surfaces with a lift of superplasticized concrete (6-inch to 8-inch slump) and thoroughly vibrate the mix.

#### 3.8 Finishing

##### A. Slabs

1. Screeding
  - a. Concrete shall be deposited in the slab from a wheelbarrow, buggy, bucket, chute, conveyor, or pump hose without segregation of coarse and fine aggregates.
  - b. Spreading of the concrete shall be performed with a square end shovel.
  - c. The concrete shall then be screeded or struck off before any excess moisture or bleed water is present on the surface.
  - d. If a vibrating screed is used, it shall be moved forward as rapidly as possible to avoid excess mortar being brought to the surface.
2. Bull Floating
  - a. The purpose of bull floating is to smooth the surface and to eliminate high and low spots.
  - b. Bull floating shall occur immediately after screeding or strike off and before bleed water accumulates on the surface, and shall be done in such a manner that the surface is not sealed.
  - c. Bull floating shall be done with a wood or magnesium float.
  - d. Do not overwork the surface.
3. Waiting Period

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Upon completion of the bull floating, the concrete shall be allowed to sit until the bleeding has stopped and the water sheen disappears, and after the concrete is firm enough to permit a person to walk on the surface leaving a foot print no greater than 1/4 inch in depth.

#### 4. Edging and Jointing

After the bleeding has stopped, sidewalks, driveways, steps, and other slabs as directed shall be edged and jointed.

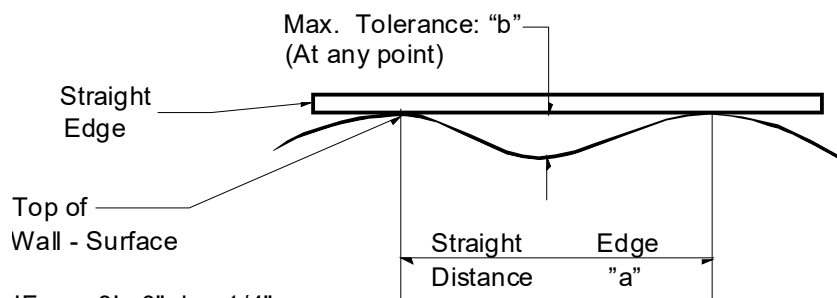
#### 5. Floating

a. The purpose of floating is to embed the large aggregate just beneath the surface of the mortar; to remove slight imperfections, bumps and voids; and to compact the concrete and consolidate mortar at the surface in preparation for final finishing.

b. After the waiting period defined above, the Contractor shall float the concrete surface using wood or magnesium hand floats or a troweling machine equipped with float shoes.

#### 6. Surface Tolerance

The surface of all slabs shall conform to the following surface tolerance:



IF: a = 8' - 0"; b = 1/4"

IF: a = 2' - 0"; b = 1/8"

IF: a = 1' - 0"; b = 1/16"

#### 7. Steel Trowel Finish

a. Unless specified otherwise, all interior slabs except stairway treads and steps shall receive a steel trowel finish.

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- b. After completion of the floating and after the concrete has hardened sufficiently to prevent drawing of moisture and fine materials to the surface and when the concrete is sufficiently hard that no mortar accumulates on the trowel, the concrete surface shall be steel trowel finished to produce a smooth hard dense, impervious surface free from defects and blemishes.
- c. The smoothness and density of the surface shall be improved by additional trowelings with time between successive trowelings to permit the concrete to harden.

#### 8. Surface Hardener

- a. Surface hardener shall be applied to concrete floors in all rooms containing mechanical equipment or corrosive interior materials and as indicated on the Drawings.
- b. Do not apply surface hardeners to floors designated to receive vinyl floor coverings.

#### 9. Broom Finish

- a. After completion of floating and after the concrete has hardened sufficiently, all stair treads, interior and exterior, and all exterior slabs including sidewalks, driveways, etc., shall receive a broom finish unless otherwise specified.
- b. The broom shall be a stiff fiber or steel tined broom that will mark the finished concrete to a depth not to exceed 1/8th of an inch. Markings or corrugations shall be transverse to the direction of travel.

#### B. Unformed Surfaces

Unformed surfaces that will not be exposed in the complete Work shall be brought to required finished elevations and left smooth and regular. Sufficient screeds shall be installed to ensure an even concrete surface, true to grade and elevation, without unacceptable local depressions.

#### C. Formed Surfaces

##### 1. Class C Finish

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- a. Forms shall be removed as soon as permissible and immediately thereafter, snap tie holes, rock pockets, air pockets over 1/2-inch depth, and other defects shall be chipped, sandblasted, or wire brushed to expose sound aggregate and mortar and then shall be pointed and thoroughly tamped with dry pack grout.
  - b. Surfaces that have been pointed shall be kept moist for a period of not less than 24 hours. If after the pointing sets and is rubbed, dusting occurs, the surface shall be refinished.
  - c. Finished surfaces shall be free from sand streaks or other voids.
  - d. All formed concrete surfaces that will not be exposed to view shall receive a Class C surface finish unless otherwise indicated.
2. Class B Finish
- a. Class B finish shall consist of a smooth finish such as can be achieved by means of plywood forms, steel forms, or form liners.
  - b. After the forms are removed, the concrete surface shall first receive a Class C finish. The surface shall then be additionally finished as necessary to produce a smooth and even surface with uniform texture, lines, and appearance, free of bulges, fins, lips, undulations, depressions, or other imperfections. Chipping, grinding, or other methods may be necessary to achieve a smooth surface.
  - c. All exposed formed concrete surfaces shall receive a Class B Finish unless otherwise indicated. Surfaces below water shall be considered exposed.
3. Class A Finish
- a. Class A finish shall consist of a sack rubbed finish as described herein. After the forms are removed, the surface shall first receive a Class B finish. Then the concrete surface shall receive a Class A sack rubbed finish.
  - b. The surface to receive the Class A finish shall be thoroughly cleaned to remove any surface film. The mortar shall be rubbed thoroughly over the surfaces with clean burlap or a sponge rubber float, so as to fill all pits, and bring the surface to a uniform texture. Mortar in excess of that required for filling the pits shall be removed.

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- c. Concrete surfaces shall be Class A finished to a depth of 4 inches below finish paving and sidewalk grades, 4 inches below building finish grade, and 1 foot below maximum water surfaces, unless otherwise indicated.
- d. Class A finished surfaces shall be kept damp for a minimum of 48 hours or until the paste has set, whichever is longer. If after the retextured surface sets and is rubbed, dusting occurs, the surface shall be refinished.
- e. All exposed surfaces of concrete building walls, retaining walls, concrete tanks, and other surfaces or structures indicated on the Drawings shall receive a Class A finish.
- f. All Class A finished surfaces shall be painted in accordance with Technical Specifications - "Painting."

#### 3.9 Protection

Every reasonable precaution shall be taken to protect finished surfaces from abrasions or other damage. Concrete surfaces or edges likely to be injured during the construction period shall be protected by leaving the forms in place or by erecting satisfactory covers. No fire shall be permitted in direct contact with concrete at any time. Concrete shall be adequately protected from drying action by sun and wind.

#### 3.10 Curing

##### A. General

- 1. All Portland cement concrete shall be cured by maintenance of proper moisture content and temperature for the development of desired concrete strength and durability. Curing shall be commenced immediately after placement of the concrete and initial finishing has been completed.
- 2. There are two systems of maintaining satisfactory moisture content:
  - a. Water curing by the continuous or frequent application of water through ponding or immersion, fog spraying or sprinkling or a saturated cover of heavy quilted cotton mats or rugs, or multiple layers of burlap.
  - b. Surface sealing for the prevention of excessive loss of water from concrete slabs by use of 4-mil polyethylene sheet or reinforced bituminous kraft paper (ASTM C171); and for exterior slabs only by the application of a liquid membrane-forming curing compound to the freshly

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placed concrete, and for walls by leaving water proof forms in place with periodic soaking.

#### B. Cure Time

All concrete shall be cured for a period of not less than 7 days after placement. If during the cure time the surrounding temperature falls below 45°F, the cure time shall be extended for the number of hours the temperature is below 45°F.

#### C. Walls

The acceptable methods of curing concrete walls are:

1. Concrete forms for walls shall be left in place and kept damp at all times during the required cure time; the wall forms may be loosened after 24 hours following the concrete placement, but water shall be flowed periodically into the space between the concrete and the form to add moisture. During the cure time, the tops of walls shall be covered with a continuously water saturated covering such as burlap or cotton mats.
2. The Contractor may remove the wall forms not less than 24 hours following the concrete placement. Curing shall then be accomplished by draping continuously water saturated heavy quilted cotton mats or rugs over the concrete walls. The water saturated coverings shall be secured to the wall to prevent air from circulating between the covering and the concrete surface.
3. After 24 hours of water cure, except as specified below, concrete curing of formed surfaces may be completed using a curing compound. However, a curing compound shall not be used on concrete surfaces that will be Class A or Class B finished, painted, waterproofed, or where other coatings or coverings are to be bonded to the surface, unless the curing compound is compatible with the final finish or the curing compound is removed by sandblasting.

#### D. Slabs

The entire surface of a newly placed concrete slab shall receive one of the water curing or sealing methods described above, or a combination thereof, beginning after finishing operations have been completed and as soon as marring of the concrete will not occur.

#### E. Curing Compounds

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1. Curing Compound shall not be used on concrete surfaces to be painted, waterproofed, moisture-proofed, Class A sack rubbed surface finished, or where other coverings are to be bonded, unless the curing compound is compatible with the final finish covering or it is to be removed by sandblasting prior to covering.
2. Generally, use of curing compounds is limited to use on concrete sidewalks, curbs, landings, driveways, catch basins, and other minor structures. Curing compound shall not be used on interior floor slabs.
3. Liquid membrane curing compounds shall be applied after finishing and as soon as the free water on the surface has disappeared and no water sheen is visible but the surface is still moist. The compound shall be applied at a uniform rate, not greater than 200 square feet per gallon using two applications (100 square feet per gallon each) at right angles to each other.

#### F. Curing and Protection in Cold Weather

Curing and protection in cold weather shall conform to ACI 306. Repair or replace concrete changed by cold weather.

### 3.11 Construction, Contraction, and Expansion Joints

#### A. General

Joints in concrete shall be horizontal level or vertical and shall be of the type and location as shown on the Drawings, or as approved by the Engineer. Joints shall be accurately located and constructed to produce straight joints. The concrete pour shall not commence until after the joint preparation has been reviewed by the Engineer.

#### B. Installation of Waterstops

1. Prior to use of the waterstop material in the field, a Sample of a fabricated cross constructed of each size or shape of material to be used shall be submitted to the Engineer for review. These Samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this Specification. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions using a thermostatically controlled heating iron.
2. Join waterstops at all intersections so that a continuous seal is provided. Center the waterstop on the joint. Secure waterstop in the correct position. In the event

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of damage to the waterstop or improper installation of waterstop, repair the waterstop in an acceptable manner to provide a water tight seal.

3. Vibrate concrete to obtain impervious concrete in the vicinity of all joints. Make a visual inspection of the entire waterstop area during concrete placement. Limit concrete placement to top of waterstop in first pass, vibrate the concrete under the waterstop, lift the waterstop to confirm full consolidation without voids, then place remaining concrete to full height.

#### C. Construction Joints

1. Construction joints, including keyways when required, shall be made as shown on the Drawings or as approved by the Engineer.
2. For construction joints without keyways, prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by sandblasting or other approved means to remove all laitance, expose the aggregate, and roughen surface to a minimum of 1/4-inch amplitude.
3. For all joints, the exposed portion of the reinforcing steel shall be cleaned and surface roughening of all concrete. The cleaning and surface roughening method shall be conducted so as not to damage the waterstop, if one is present.
4. The surface of the hardened concrete may be roughened by one of the following methods:
  - a. Sandblasting the foundation and reinforcing dowels after the concrete has fully cured to remove all laitance and spillage, and to expose sound aggregate.
  - b. Water blasting the foundation and reinforcing dowels after the concrete has partially cured to remove all laitance and spillage, and to expose sound aggregate.
5. Horizontal Construction Joints
  - a. For all horizontal construction joints with waterstop, prior to placement of the abutting concrete, thoroughly clean the concrete, exposed waterstop, and reinforcing steel, etc., and saturate with water; cover the horizontal surfaces with at least 2 inches of grout and immediately place concrete.



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- b. Limit the concrete lift immediately on top of the grout to 12 inches and thoroughly vibrate to mix and consolidate the grout and concrete together.
- c. Provide positive measuring devices such as bucket or other device that will contain only enough grout for depositing in one place in the wall to ensure that a portion of the form does not receive too much grout.
- d. The depositing of grout from pump hoses or large concrete buckets will not be permitted, unless inspection windows close to the joint are available to allow visual measurement of grout thickness and means are available for removal of excess grout.
- e. For all horizontal construction joints without waterstops and all vertical construction joints, thoroughly clean and saturate the hardened concrete surface with water prior to placement of the new abutting concrete.

#### D. Sawed Contraction Joints

When called for on the Drawings, the Contractor shall make saw cut contraction joints at the location, spacing, and layout shown on the Drawings. Joints shall be sawed as soon as the concrete is hard enough not to be torn or damaged by the blade. Joints shall be sawed approximately 1/8-inch in width to a depth of one-quarter of the slab thickness. When called for on the Drawings, saw cut joints shall be filled with pourable or gun grade joint filler.

#### E. Formed Contraction Joint

When called for on the Drawings, the Contractor shall make contraction joints as detailed including keyways, waterstop, dowels, reinforcement, sealants, etc. Prior to placement of the new concrete, a bond breaker shall be applied to the existing hardened concrete. Bond breakers shall not be applied to waterstop material.

#### F. Expansion Joints

##### 1. General

- a. Expansion joints shall be made as shown on the Drawings and as approved by the Engineer. The pre-molded joint filler shall be of sufficient width to completely fill the joint space.

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- b. If a waterstop is in the joint, the pre-molded joint filler shall be accurately cut to butt tightly against the waterstop and the side forms.
  - c. At locations where joint sealant or filler is to be applied, the pre-molded joint filler shall be precut to the required depth, see details on Drawings.
  - d. Cavities for joint sealant shall be formed with either precut, pre-molded joint filler; or smooth, accurately-shaped material that can be removed.
  - e. Concrete shall be thoroughly vibrated along the joint form to produce a dense, smooth surface. Surface irregularities along the joint sealant cavity, due to improper concrete consolidation or faulty form removal, shall be repaired with an approved compound compatible with the joint sealant in a manner that is satisfactory to the sealant manufacturer.
2. Bituminous Type Pre-molded Joint Filler
- Drive nails at about 1 foot on centers through the filler to provide anchors into the concrete when it is placed. Place pre-molded joint filler in forms in the proper position before concrete is poured. Install pre-molded joint filler in all sidewalks to provide expansion and contraction joints at not more than 25-foot intervals.
3. Pourable Joint Filler
- a. Install pourable joint fillers in accordance with the manufacturer's instructions, except the entire joint above the waterstop shall be filled with filler as shown.
  - b. Thoroughly clean joints by mechanically roughening and cleaning, using a motorized wire brush or other motorized device, the concrete surfaces of each side of the joint from the plastic waterstop to the top of the joint, dry the joint, and remove all dust and foreign materials using clean and dry high pressure air; prime before pouring the filler. Avoid damaging the waterstop. Primer shall be compatible with filler material.
4. Rubber Asphalt Type
- a. Heat rubber asphalt hot pour filler material in a double-walled boiler and place in the joint by means of a nozzle from a portable pouring type container. Prevent spillage outside of the joint.

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- b. Begin pouring joint filler at the bottom of the horizontal joint and proceed upwards in a manner that will preclude the possibility of trapping air in the joint. Use masking tape at each side of joint to assist in cleaning all spillage.
- c. For cold applied, two-component fillers, follow manufacturer's written instructions. Use masking tape on top of slabs at sides of joints; clean all spillage.

#### 3.12 Pumped Concrete

##### A. General

Pumping of concrete will be permitted only with the Engineer's agreement. If, in the Engineer's opinion, 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

1. The Contractor shall have a standby pump, conveyor system, crane and concrete bucket, or other system acceptable to the Engineer, on the Site during pumping, in order to provide adequate redundancy to assure completion of the concrete placement without cold joints in the event of breakdown of the primary placing equipment.
2. The minimum diameter of the hose (conduit) shall be 4 inches. Pumping equipment and hoses (conduits) that, in the opinion of the Engineer, are not functioning properly, shall be replaced.
3. Aluminum conduits for conveying the concrete shall not be used.
4. A cement-water slurry shall be pumped through the lines and hoses before starting the concrete mix through the pump. The pump shall be operated in a manner that produces a continuous stream of concrete without air pockets or segregation.

##### C. Concrete Samples

Concrete samples for slump and test cylinders will be taken at the placement (discharge) end of the line.

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##### 3.13 Tolerances

###### A. General

Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in these Specifications, permissible deviations will be in accordance with ACI 347. Notations on the Drawings of specific maximum and minimum tolerances shall govern if in conflict with these Specifications.

###### B. Permissible Tolerance

Unless otherwise indicated, all columns, beams, slabs, openings, reinforcing bars, waterstops, etc., shall be accurately located to within 1/4 inch. The permissible tolerance of the inside and outside wall surface shall be 3/16-inch plus or minus for linear walls and 3/8-inch plus or minus for circular walls. The tolerance of alignment as to the actual position of inside and outside surface is 3/8-inch plus or minus. All transitions from plus to minus shall be gradual, even and smooth, and without abrupt changes in the surfaces.

###### C. Failed Tolerances

Should the completed Work fail to meet the tolerances specified herein, the Contractor shall bear the expense of any remedial work required to repair or replace the defected, as directed by the Engineer. Surface defects and irregularities are defined as finished and are to be distinguished from tolerances.

##### 3.14 Testing and Quality Control

###### A. General

The Contractor shall provide and maintain a quality control program that will ensure the quality of the Work and materials incorporated into the Project. See the Quality Control section of the General Requirements. Materials that fail to meet Contract requirements shall not be incorporated into the Work.

###### B. Structural Concrete

###### 1. Cement Content

The cement content shall be tested in accordance with ASTM C85 and shall meet the requirements specified above in "Proportioning of Concrete Mix."

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2. Fine and Coarse Aggregate

Aggregate size shall meet the requirements of ASTM C33.

3. Slump

Concrete shall be tested for slump in accordance with ASTM C143.

4. Air Content

Air content shall be tested in accordance with ASTM C231 and shall meet the requirements specified above in "Proportioning of Concrete Mix."

5. Compressive Strength

a. Sample concrete cylinders may be taken from the Work by the Engineer or their representative. At least three identical cylinders may be taken not less than once a day, nor less than once for each 50 cubic yards of concrete placed. When the frequency of testing will provide less than five tests for a given class of concrete, tests may be made from at least five randomly selected batches or from each batch if fewer than five are used, or as required by the Engineer.

b. All cylinders shall be prepared and cured in accordance with ASTM C31 and tested in accordance with ASTM C39. One cylinder shall be tested at the age of 7 days and two at the age of 28 days. Each strength test result shall be the average of the two cylinders from the same Sample tested at 28 days.

c. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the required minimum compressive strength and no individual strength test result falls below the required minimum compressive strength by more than 500 psi.

6. Concrete Core Samples

a. Samples shall be taken according to ASTM C42. Three cores shall be taken for each unsatisfactory strength test. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 85°, relative humidity less than 60 percent) for 7 days before test and shall be tested dry. If the concrete in the structure will be more than

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superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet.

- b. Concrete in the area represented by the core tests may be considered structurally adequate if the average of the three cores is equal to at least 85 percent of the minimum compressive strength and if no single core is less than 75 percent of the minimum compressive strength. The decision as to whether the concrete is structurally adequate shall be at the sole discretion of the Engineer. A cost adjustment may be required as a condition of acceptance.

#### 7. Admixtures

Admixtures shall meet the requirements listed under Part 2 - Materials, "Concrete Admixtures."

#### 8. Visual Inspection

The concrete shall be free of rock pockets, cracks, and other structural and water holding defects. Any defective concrete shall be repaired as approved by the Engineer. Any defective concrete with exposed reinforcing steel shall either be repaired or demolished and replaced at the sole discretion of the Engineer.

#### C. Defective Concrete

1. For each unsatisfactory strength test, concrete core samples shall be taken according to ASTM C42. A minimum of three cores shall be taken for each unsatisfactory strength test. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 85°, relative humidity less than 60 percent) for 7 days before test and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet.
2. Concrete in the area represented by the core tests may be considered structurally adequate if the average of the three cores is equal to at least 85 percent of the minimum compressive strength and if no single core is less than 75 percent of the minimum compressive strength. The Engineer may require additional core tests to determine the limits of the defective concrete. The cost of core tests shall be borne by the Contractor. The decision as to whether the

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concrete is structurally adequate shall be at the sole discretion of the Engineer. A cost adjustment may be required as a condition of acceptance.

#### D. Visual Inspection

All concrete shall be free of rock pockets, cracks, and other structural and water holding defects. Any defective concrete shall be repaired as approved by the Engineer. Any defective concrete with exposed reinforcing steel shall either be repaired or demolished and replaced at the sole discretion of the Engineer.

### 3.15 Water Leakage Tests

#### A. Testing Procedure

1. All water-holding structures shall be subjected to leakage tests after the concrete has been cured and obtained its design strength, and before backfill or other work which will cover the concrete surfaces of the walls is begun. The purpose of this test is to determine the integrity of the finished concrete and to show that the exposed wall surfaces are visually acceptable. Therefore, all other equipment, i.e. stop gates, sluice gates, etc., or temporary bulkheads should be made watertight prior to the test. Both the correction for excessive leakage and the removal of the damp or wet spots on walls shall be required to pass the leakage test.
2. Water-holding structures shall be filled with water or plant effluent to 1 foot above the maximum operating liquid level shown on the Drawings prior to leak testing. After these structures have been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the basin is complete. The change in water surface shall then be measured for a 24-hour period.
3. During the test period, all exposed portions of the structure shall be examined for dampness or leaks, and all visible leaks or damp spots shall be marked; such leaks or damp spots shall later be patched or corrected in a manner acceptable to the Engineer prior to additional leakage testing.
4. If the drop in water surface in the 24-hour period exceeds one gallon per thousand gallons of volume of liquid contained in the water-holding structure, after accounting for evaporation and precipitation in open basins, or if damp spots or any seepage is present on the walls or other areas exposed to view, the leakage shall be considered excessive and the leakage test will be considered to

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have failed. Evaporation shall be determined by floating an evaporation pan in the structure during the test period.

5. Water required for the testing shall be provided by the Contractor.

#### B. Excessive Leakage

1. If the leakage is excessive or if damp spots and observed seepage are present on exposed surfaces, the water-holding structure shall be drained, all leaks and damp spots previously marked shall be repaired to the satisfaction of the Engineer.
2. Cracks shall be "square cut" and sealed with epoxy joint sealer in accordance with manufacturer's instructions.
3. Any leakage or seepage through the joints shall be repaired to the satisfaction of the Engineer. The Contractor's method of repair shall be subject to the review and acceptance of the Engineer.

#### C. Retesting for Leakage

1. The water-holding structure shall then be refilled and again tested for leakage, and this testing and repair process shall be repeated as many times as necessary until the leakage test passes.
2. This process shall be continued until the drop in water surface in a 24-hour period with the basin full is less than one gallon per thousand gallons of the volume of liquid held in the basin and all damp spots and seepage disappear when the structures are full of water.
3. All repairs of faulty workmanship and materials, and additional tests, shall be made by the Contractor in an acceptable manner, at no additional cost to the Owner.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 Basis

See Technical Specifications - "Measurement and Payment" for a description of the basis of measurement and payment for Work performed under this Contract.



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##### **4.2 Water Leakage Tests**

All costs for testing the water-holding structures shall be borne by the Contractor.

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### STORM DRAINAGE

#### PART 1 - GENERAL

##### 1.1 Scope

These Specifications cover the furnishing and installation of gravity storm drain lines, catch basins, manholes, and miscellaneous appurtenances. The Work includes, unless otherwise specified, furnishing all labor, materials, tools, equipment, and incidentals required to construct a complete storm drainage system ready for service as outlined in the Drawings and Specifications.

##### 1.2 Specification References

Specification references made herein for manufactured materials such as pipe, fittings, and manhole rings and covers refer to designations for the American Water Works Association (AWWA), the American Society for Testing and Materials (ASTM), or the American Association of State Highway and Transportation Officials (AASHTO) as they are effective on the date of call for Bids.

##### 1.3 Catalog Information

Catalog information on all equipment to be installed shall be submitted to the Engineer for approval prior to installation.

##### 1.4 Care and Handling of Materials

- A. Adequate precautions shall be taken to prevent damage to pipes, fittings, and all other materials used in construction of the storm drainage system. Pipe and other materials during transport shall be secured individually by use of wood spacer blocks or wood crates, or otherwise protected to prevent collision of individual pieces and possible subsequent damage.
- B. All pipe and fittings shall be loaded and unloaded in a manner to prevent shock or damage. Under no circumstances shall such material be dropped. All materials on the ground shall be protected from damage. All pipes, fittings, and all other materials used in the construction of the drainage system shall be carefully inspected by the Contractor prior to installation. All defective materials shall be rejected. All materials that are delivered considerably in advance of their installation shall be stored in a satisfactory manner. The Contractor will receive no payment for materials on hand that are not so protected.
- C. Proper materials, tools, and equipment shall be used by the Contractor for safe and convenient prosecution of the Work. All pipes, fittings, etc., shall be carefully lowered

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into the trench piece by piece in such a manner to prevent any damage to the materials. Under no circumstances shall materials be dropped or dumped into the trenches.

#### 1.5 Certification by Manufacturer

The Contractor shall furnish to the Engineer a sworn statement from the manufacturer stating that inspection and all specified tests have been made on the supplied material and that the results thereof comply with appropriate Specifications. The statement shall also state that all materials furnished are in accordance with these Contract Documents and that all materials are new. Final payment will not be made until proper certifications are submitted to the Engineer.

#### 1.6 Alternate Materials

Alternate materials will be considered in accordance with the General Conditions.

#### 1.7 Submittals

The Contractor shall submit Shop Drawings for proposed pipe connections to catch basins, area drains, and field inlets.

### PART 2 - MATERIALS

#### 2.1 Gravity Storm Drains

*Not used*

#### 2.2 Manholes

*Not used*

#### 2.3 Catch Basins, Area Drains, and Field Inlets

*Not Used*

#### 2.4 Culverts

##### A. Corrugated Steel

Culverts shall be Type 2 corrugated steel pipe and shall be a minimum 14-gauge with 2-2/3-inch x 1/2-inch corrugations. Fabrication of pipe shall conform to AASHTO M 274 and AASHTO M 36 specifications. Joints shall be made with corrugated steel culvert bands over 3/8-inch neoprene gaskets. Culvert bands shall be 12 inches wide.

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### STORM DRAINAGE

#### PART 3 - EXECUTION

##### 3.1 Existing Utilities

The Contractor shall be responsible for the actual locating and protecting of existing utilities. If a conflict develops between the design line and grade of a pipeline and an existing utility, the Engineer may adjust the pipeline grade or have the existing utility relocated. See the General Requirements for further requirements.

##### 3.2 Restoration, Finishing, and Cleanup

The Contractor shall restore or replace all paved surfaces, graveled surfaces, curbing, sidewalks, trees and shrubbery, lawns, pastures, fences, and other existing facilities to their original condition. See Technical Specifications - "Surface Restoration" for specific requirements.

##### 3.3 Installation of Gravity Storm Drains

###### A. Trench Excavation and Backfill

Trench excavation and backfill shall be performed as specified in the Technical Specifications - "Excavation and Backfill of Trenches." When installation involves replacement of an existing line, trench excavation and backfill shall include the removal of existing curbs, sidewalks, paving and base rock, and also the existing line.

###### B. Installation of Pipe

1. Gravity storm drain pipe shall be installed in accordance with the best current practices and as required by the manufacturer. Gravity storm drain pipe, unless otherwise approved by the Engineer, shall be laid by progressing upgrade from the existing or newly constructed storm drain. Each pipe shall be properly bedded so as to be supported along the full length of the pipe.
2. All foreign matter and gravel shall be removed from the inside of the pipe and fittings before being installed, and the pipe and fittings shall be kept clean during placement. No pipe shall be laid when conditions exist that, in the opinion of the Engineer, are unsuitable for the placing of pipe. All pipe and manholes shall be covered or plugged at night.
3. The Contractor may elect, at their own option, to drain or pump groundwater from the trenches into previously placed new storm drain lines as long as adequate disposal is provided. Adequate provisions shall be made by the Contractor for final disposal of the groundwater from trenches as approved by

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the Engineer. Discharge water into new storm drain lines shall be properly screened to prevent siltation, debris, and/or gravel from entering the receiving waterway. At the termination of dewatering operations, the Contractor shall thoroughly clean the storm drain lines that were used. No storm drain lines will be accepted as completed until being cleaned and until approved by the Engineer.

C. Testing

*Not used*

**3.4 Manhole Installation and Connections**

*Not Used*

**3.5 Catch Basins, Area Drains, and Field Units**

*Not used*

**3.6 Culverts**

- A. Culverts shall be installed in the location and at the grade shown on the Drawings and specified herein.
- B. Culverts shall be bedded and backfilled uniformly on both sides of the pipe at the same time to prevent displacement or buckling of the pipe. Bedding material shall be worked carefully under the pipe haunches and then compacted. Bedding and backfill material shall consist of select native material free of particle sizes greater than 1-1/2-inch in diameter.

**3.7 Cleaning and Flushing of Completed and Tested Storm Drains**

*Not used*

#### **PART 4 - MEASUREMENT AND PAYMENT**

**4.1 Basis**

See Technical Specifications - "Measurement and Payment" for a description of the basis of measurement and payment for the Work performed under this Contract.

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**PART 1 - GENERAL**

**1.1 Scope**

The basis for measurement and payment for all Work performed under this Contract shall be as listed in the "Bid Schedule." Unless the Work to be performed is specifically called out to be measured and paid for in the Bid Schedule, payment for such Work shall be included in other applicable items of the Bid Schedule. There shall be no separate measurement and payment for any such Work not specifically listed in the Bid Schedule.

**1.2 Method of Payment**

Items listed in the Bid Schedule as lump sum shall be on a lump sum all required basis. No direct measurement will be made for lump sum bid items. Bid items calling for unit prices show estimated quantities of Work to be performed. These quantities, although shown with as much accuracy as possible, are approximate only and are for bidding purposes only. The Owner reserves the right to increase or decrease the amount of these quantities as may be deemed necessary. Payment to the Contractor shall be made on the quantity of Work actually performed by the Contractor.

The summation of all bid items under the Bid Schedule shall equal all Work required by the Drawings and Specifications regardless of whether individual items of Work are described under bid item descriptions or not. Payment shall be made at the unit or lump sum prices listed in the Bid Schedule. The prices listed therein shall be payment in full for all labor, tools, equipment, materials, etc., required to construct respective bid items according to the Contract Documents, including all Work and materials incidental thereto.

**1.3 Payment for Partially Completed Work**

A. General

Payment for unit price bid items and lump sum bid items only partially completed at the end of monthly pay periods shall be based on a percentage of Work completed as determined by the Engineer. An example is the construction of pipelines where the unit bid item price includes the excavation and backfill of the trenches, installation of pipe, trench compaction, flushing, and testing, although the Contractor may have installed a certain footage of pipeline yet has not completed the testing and/or restoration work. The actual payment for that bid item will be reduced to reflect the actual amount of Work completed.



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B. Pipelines

For pipelines, partial payment for Work not complete will be as shown in the following table unless determined otherwise by the Engineer:

<b>Partial Payment for Pipeline</b>	
<b>Description of Work</b>	<b>Percentage of Linear Feet Installed</b>
Excavation, Backfill, and Compaction of Trench and Installation of Pipe	75%
Flushing, Pressure, and Leakage Testing and Disinfection of Pipeline when Required	15%
Surface Restoration Other than that Covered by Other Bid Items	10%
Total	100%

C. Valves, Meters, Manholes, Cleanouts, and Other Similar Work

For valves, meters, manholes, cleanouts, and other similar work items, the partial payment for Work not complete will be as shown in the following table unless otherwise determined by the Engineer.

<b>Partial Payment for Valves, Meters, Manholes, Cleanouts, and Other Similar Work Items</b>	
<b>Description of Work</b>	<b>Percentage of Each Installed</b>
Installation of Work Item	75%
Installation of Work Item to Finished Grade and Final Restoration	25%
Total	100%

**1.4 Payment Items**

A. Numbering

The numbering of the payment items listed below may not be the same as the numbering for bid items in the Bid Schedule.

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B. Method of Payment

1. Mobilization/Demobilization

Measurement for payment for mobilization/demobilization shall be on a lump sum all required basis. The amount for mobilization/demobilization shall not exceed 5 percent of the total bid price. Payment shall be made at the lump sum price stated in the Bid Schedule for "Mobilization/Demobilization." Seventy-five percent of the bid amount for mobilization/demobilization will be made on the first payment request and the remaining 25 percent of the bid amount will be paid on the final payment request.

2. Temporary Protection and Direction of Traffic/Project Safety

Measurement for payment for temporary protection and direction of traffic/project safety shall be on a lump sum all required basis. Payment shall include all supervision, planning, training, signs, barricades, barriers, lights, cones, flag persons, and such devices and work, etc., as may be required during execution of the Work. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Temporary Protection and Direction of Traffic/Project Safety."

3. Temporary Erosion Control

Measurement for payment for temporary erosion control shall be on a lump sum all required basis. Payment shall include all materials, construction, deconstruction, etc., as may be required during execution of the work and as defined on the 1200-C Erosion and Sediment Control Plan. Payment shall be made at the lump sum price stated in the Bid Schedule for "Temporary Erosion Control."

4. Rock Excavation

Measurement for payment for rock excavation in trenches shall be on a cubic yard basis. The pay limits shall be the cubic yardage of solid rock actually excavated within the normal width of the trench and which is actually required for the proper pipe installation. Over-excavated areas will not be included in pay quantities. The pay width shall be limited to 24 inches or 1 foot greater than the outside diameter of the pipe, whichever is greater. The pay depth shall be limited to the actual depth of solid rock excavated to a maximum depth of 4

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inches below the pipe bottom. The Engineer shall be notified prior to placing pipe and backfill so that pay quantities may be determined. Payment shall be made at the unit price stated in the Bid Schedule for "Rock Excavation."

5. Brush and Grub

Measurement for payment for brush and grub sand associated work as defined on the Drawings shall be on a lump sum all required basis. Payment shall include all work needed to ensure well compacted and stable final backfill and maintenance path over the pipeline through the removal of vegetative material as necessary within the clearing limits, hauling, re-use and disposal of material as defined on the Drawings. Clearing limits are estimated as a maximum of 15 feet downhill and 5 feet uphill of existing Upper Phillips Ditch Centerline. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Brush and Grub."

6. HDPE Water Line

Measurement for payment for water line as defined on the Drawings, shall be on a linear foot basis for the various sizes and types listed in the Bid Schedule. Lengths of pipe shall be determined by measuring along the centerline of the pipe as installed from one end to the other. This item shall include all fittings, location wire, flexible couplings and other items, except valves, installed in the line as detailed on the Drawings. There is no specified pay depth for water line. The depth shall be as shown on the Drawings and as required in the field for proper installation. No field measurement will be made for depth. Payment shall be made at the unit price stated in the Bid Schedule for "12-inch HDPE Water Line" and "16-inch HDPE Water Line".

7. Mainline Standpipe Airvent

Measurement for payment for mainline standpipe airvent and associated work as defined on the Drawings shall be on a per each basis. This item includes the 4" HDPE Branch Saddle, 4" HDPE To Stainless Steel FNPT, 4" Galvanized Steel Pipe Nipple 6 ft Length, elbows, screen for a complete installation as shown on the Drawings. Payment shall be made at the unit price stated in the Bid Schedule for "Mainline Standpipe Airvent."

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8. Tree Removal

Measurement for payment for tree removal shall and associated work as defined on the Drawings shall be on a per each basis for the various sizes, tree type and type of removal. Type of removal includes either cut and deck on-site, cut and haul offsite to staging area, drop and leave, partial removal and limbing only, full tree and stump removal and disposal or any combination thereof as defined on the Drawings. Payment shall be made at the unit price stated in the Bid Schedule for "Tree Removal."

9. Irrigation Sump Assembly with Pump Access Port Installed

Measurement for payment of irrigation sump assembly with pump access port and associated work as defined on the Drawings shall be on a per each basis for the various sizes and configurations. Includes 12" HDPE Pipe PE 4710 Fabricated Cross SDR 21 (typical), Spools, Bottom Cap, 12" HDPE Flange Adaptor and Ductile Iron Backing Ring, Ductile Iron Blind Flange with 4" tap-on-pipe threaded port, 4" MNPT Nipple, 4" FNPT Gate Valve, 36" CMP Housing Assembly. Includes various sizes of turnouts with HDPE fusion welded branch saddle, HDPE flange adaptor, flanged valve, valve can, PVC blind flange and 4x4 pressure treated wood marker post. Payment shall be made at the unit price stated in the Bid Schedule for "Irrigation Sump Assembly with Pump Access Port Installed".

10. Irrigation Sump Assembly without Pump Access Port Installed

Measurement for payment of irrigation sump assembly with pump access port and associated work as defined on the Drawings shall be on a per each basis for the various sizes and configurations. Includes 12" HDPE Pipe Fabricated Cross SDR 21 4710 resin (typical), Spools, Bottom Cap, 12" HDPE Flange Adaptor and Ductile Iron Backing Ring, Ductile Iron Blind Flange. Includes various sizes of turnouts with HDPE fusion welded branch saddle, HDPE flange adaptor, flanged valve, valve can, PVC blind flange and 4x4 pressure treated wood marker post. Payment shall be made at the unit price stated in the Bid Schedule for "Irrigation Sump Assembly without Pump Access Port Installed".

11. Irrigation Sump Assembly with Manhole Cleanout and Reducer Installed

Measurement for payment of irrigation sump assembly with manhole cleanout and reducer and associated work as defined on the Drawings shall be on a per each basis. Includes 24" HDPE Pipe Fabricated Cross SDR 21 4710 resin (typical), HDPE 24"x16" Eccentric Reducer, HDPE 24"x12" Eccentric Reducer, 16" and 12"

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HDPE Spools, 24" HDPE Bottom Cap, 24" HDPE Flange Adaptor and Ductile Iron Backing Ring, Ductile Iron Blind Flange. Includes 10" HDPE fusion welded branch saddle, 10" HDPE flange adaptor, 10" flanged gate valve, valve can, and 4x4 pressure treated wood marker post. Payment shall be made at the unit price stated in the Bid Schedule for "Irrigation Sump Assembly with manhole cleanout and reducer installed".

12. Irrigation Turnout Assembly with Concrete Sump Installed.

Measurement for payment of irrigation turnout assembly with concrete sump and associated work as defined on the Drawings shall be on a per each basis. Includes 6" HDPE Branch Saddle, 6" HDPE Flange Adaptor, 6" Flanged Butterfly Valve buried service, Valve Can, 6" Sch 40 Galvanized Steel Pipe Spool, Concrete sump, and connection to existing pipe. Payment shall be made at the unit price stated in the Bid Schedule for "Irrigation Turnout Assembly with Concrete Sump Installed".

13. Irrigation Turnout Pressurized Pipe On-farm Delivery

Measurement for payment of irrigation turnout pressurized pipe on-farm delivery and associated work as defined on the Drawings shall be on a per each basis. Includes 6" HDPE pipe, 6" flanged slow opening/closing butterfly valve above ground, 1.5" combination airvent, pressure gauge with stopcock valve, 6" totalizing flow meter, all associated appurtenances and work to slipline 6" HDPE through existing 18" CMP Culvert under Little Applegate Road. Payment shall be made at the unit price stated in the Bid Schedule for "Irrigation Turnout Pressurized Pipe On-Farm Delivery".

14. Irrigation Delivery Pipe and Components

Measurement for payment for irrigation delivery pipe and components shall be on a lump sum all required basis. Payment shall include all materials such as pipe, fittings, valves, valve keys, and all other associated work, designs, alternative materials, etc. as defined on the Drawings and not part of other bid items. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Irrigation Delivery Pipe and Components."

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15. Inlet Structure

Measurement for payment for inlet structure and associated work as defined on the Drawings shall be on a lump sum all required basis. Payment shall include all materials as defined on the Drawings such as concrete structure, bedding, backfill, steel debris grate, rock riprap approach apron, 16" Galvanized Steel pipe spool, 16" MarMac coupler, 6" standpipe airvent, tracer wire segment and handhole, failsafe flood control spillway, etc. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Inlet Structure."

16. Outlet Structure

Measurement for payment for outlet structure and associated work as defined on the Drawings shall be on a lump sum all required basis. Payment shall include all materials as defined on the Drawings such as concrete structure, bedding, backfill, rat guard, rock riprap outfall apron, 12" Galvanized Steel pipe spool, 12" MarMac coupler, 6" headgate, 6" Steel pipe spool through ditch bank with 1.5" standpipe airvent, 6" drain pipeline down to Lower Phillips Ditch, probe well and staff gauge, wood check boards, tracer wire segment and handhole, etc. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Outlet Structure."

17. Cantrall Gulch Drainage

Measurement for payment for Cantrall gulch drainage shall be on a lump sum all required basis. Payment shall include all associated work and materials as defined on the Drawings such as rock lined drainage crossing crushed rock, riprap, earthwork, roadside ditch expansion, materials and installation of 18" CMP 14-gauge culvert pipe under Little Applegate Road with outlet riprap apron, etc. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Cantrall Gulch Drainage."

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18. Grotto Drainage

Measurement for payment for grotto drainage shall be on a lump sum all required basis. Payment shall include all associated work materials as defined on the Drawings such as rock lined drainage crossing crushed rock, riprap, earthwork, etc. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Grotto Drainage."

19. Hopkins Drainage

Measurement for payment for Hopkins drainage shall be on a lump sum all required basis. Payment shall include all associated work and materials as defined on the Drawings such as rock lined drainage crossing crushed rock, riprap, earthwork, 12" CMP pipe, etc. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Hopkins Drainage."

20. Road Crossing Carrier Pipe

Measurement for payment for road crossing carrier pipe and associated work as defined on the Drawings, shall be on a linear foot basis. Lengths of pipe shall be determined by measuring along the centerline of the pipe as installed from one end to the other. This item shall include 18" corrugated HDPE Pipe, removal and salvage of existing pipe, utility adjustments and replacements, if necessary, carrier pipe filling, carrier pipe end caps, tracer wire, tracer wire handholes, gravel driveway re-build, etc. There is no specified pay depth for road crossing carrier pipe. The depth shall be as defined on the Drawings and as required in the field for proper installation. No field measurement will be made for depth. Payment shall be made at the unit price stated in the Bid Schedule for "18-inch Road Crossing Carrier Pipe".

21. Site Revegetation and Stabilization

Measurement for payment for site revegetation and stabilization and associated work, shall be on a lump sum all required basis. This item shall include seed and weed free straw mulch materials, scarifying soil, and preparing areas for seeding, spreading seed and straw. Initially seeding and mulch to be placed immediately after final backfill according to Technical Specifications, Section 2, Surface Restoration. Any additional seeding after the initial seeding and mulching shall

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be the responsibility of the property owners. Stabilization refers to placing any limbs, slash, brush, or other woody debris, absent any invasive species, which was removed as part of Grub and Brush on the newly exposed down sloping earth. Clearing the maintenance path as defined on the Drawings. Payment shall be made at the lump sum price stated in the Bid Schedule for "Site Revegetation and Stabilization".

**PART 2 - MATERIALS - NOT USED**

**PART 3 - EXECUTION - NOT USED**

END OF SECTION