



SPECIFICATION MANUAL

**City of Loveland
Parks & Recreation Department**

**Bid No. 2016-30
LOVELAND SPORTS PARK
PHASE II CONSTRUCTION DOCUMENTS**

April 5, 2018

Project No. PKLSP2

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work by Owner.
4. Work under separate contracts.
5. Access to site.
6. Work restrictions.
7. Specification and Drawing conventions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Loveland Sports Park – Phase II; Project No. PKLSP2.

1. Project Location: 950 North Boyd Lake Avenue, Loveland, CO 80537.

- B. Owner: City of Loveland.

1. Owner's Representative: Scott Sinn, Parks & Recreation; 970-962-2455.

- C. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Lead Consultant: Roger Burkart, Design Concepts; 303-664-5301. Landscape Architecture Consultant has prepared the following portions of the Contract Documents:
 - a. Design for new athletic fields, landscape, irrigation, fencing, walkways and site furnishings.
2. Civil Engineer: Howard McHenry, JVA Incorporated; 303-444-1951. Civil Engineering Consultant has prepared the following portions of the Contract Documents:

- a. Design for new parking, roadways, grading, drainage, utilities and demolition.
- 3. Architect: Kris Lee, Kenny Lee Architecture Group; 970-663-05481. Architecture Consultant has prepared the following portions of the Contract Documents:
 - a. Design for new combined restroom and shade shelter, large shelter, concession building addition, and addition to the existing maintenance building.
- 4. Structural Engineer: Blake Larson, Larson Structural Design; Structural engineering for portions of the Contract Documents:
 - a. Structural design for buildings and shelters.
- 5. Mechanical/Electrical: Jeremy Babilonia and Chris Weaver, Pivotal Engineering; 970-310-3201. Mechanical and Electrical Consultant has prepared the following portions of the Contract Documents:
 - a. Design for new parking lot, pedestrian and shelter lighting, as well as mechanical and electrical design for new buildings.

D. Construction Manager: Merinda Bennett, City of Loveland; 970-962-3434.

- 1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and each Contractor.

E. Project Coordinator for Multiple Contracts: Owner shall serve as Project coordinator.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

- 1. Work is for the construction of Phase II of the Loveland Sports Park, including grading, drainage, demolition, parking and drives, restroom, building addition, shelter, concessions, landscape, irrigation, signage, fencing and site furnishings.

B. Type of Contract:

- 1. Project will be constructed under contract with a single general contractor and their subconsultants.

1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to limits of work indicated on Contract Documents.
 - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction. Access for construction and construction-related activities for the general contractor and subcontractors is restricted to the north gravel road.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 8 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Weekend Hours: Require Owner permission.
 - 2. Early Morning Hours: Only with Owner approval.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 01: Water Line Extension.

1. Base Bid: No additional water line on the project.
2. Alternate: Add an additional 8" PVC water line to the project as indicated on Sheet C2.0 and further detailed on Sheet CD2.0.

B. Alternate No. 02: Shelter #2.

1. Base Bid: No additional Shelter on the project.
2. Alternate: Add an additional Shelter to the project as indicated on Sheet L1.1, Detail 3, as well as associated tables and grills shown on Sheet L1.1.

C. Alternate No. 03: Concession Addition

1. Base Bid: No addition to the existing Mixed Use #2 Building
2. Alternate: Add an additional room for Concession onto the existing Mixed Use #2 Building near the Championship Field as indicated on Sheet A5.4.

D. Alternate No. 04: Trash Enclosure

1. Base Bid: No trash enclosures included on the project. Leave site as is.
2. Alternate: Add trash enclosures and concrete pads to the site as indicated on Sheet L1.0 and further detailed on Sheet L3.1, Detail 2.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A or approved equal.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.

- c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. Certificates and qualification data, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Cost information, including a proposal of change, if any, in the Contract Sum.
 - i. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - j. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Owner's Action: If necessary, Owner will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Owner will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Owner does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Owner will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - d. Requested substitution is compatible with other portions of the Work.
 - e. Requested substitution has been coordinated with other portions of the Work.
 - f. Requested substitution provides specified warranty.
 - g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 7 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish

times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.

- 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
- 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
- 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
- 4. Include costs of labor and supervision directly attributable to the change.
- 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
- 7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Construction Manager will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Construction Manager may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Owner through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Owner.
 - c. Owner's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
4. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Construction Manager and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use forms acceptable to Construction Manager and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.
- D. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Sustainable design submittal for project materials cost data.
 4. Contractor's construction schedule (preliminary if not final).
 5. Products list (preliminary if not final).
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of site work permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
- F. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- G. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone

numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 - 2. File Preparation Format: DWG, Version 2018, operating in Microsoft Windows operating system.
 - 3. File Submittal Format: Submit or post coordination drawing files using PDF format.
 - 4. Owner will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Owner makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in AutoCAD Civil 3D 2018.

- c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Owner will return without response those RFIs submitted to Owner by other entities controlled by Contractor.
 - 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Owner.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's suggested resolution affects the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Owner.
 - 1. Attachments shall be electronic files in PDF format.
- D. Owner's Action: Review each RFI, determine action required, and respond. Allow seven working days for Owner's response for each RFI. RFIs received by Owner after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.

- c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Owner.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Owner response was received.
- F. On receipt of Owner action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Owner within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Owner's Digital Data Files: Digital data files of Owner's CAD drawings provided by Owner for Contractor's use during construction.
 - 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 - 2. Owner makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 - 3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD Civil 3D 2018.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Owner, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Owner of scheduled meeting dates.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner, but no later than 60 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Owner, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants

- at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- C. Event: The starting or ending point of an activity.
- D. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.

2. PDF file.
- B. Startup construction schedule.
 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Microsoft Project 2016 is preferred.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Site Condition Reports: Submit at time of discovery of differing conditions.
- E. Unusual Event Reports: Submit at time of unusual event.

1.5 COORDINATION

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

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 1. Use Microsoft Project, for current Windows operating system.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Owner.
 2. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 3. Testing Time: Include no fewer than 5 days for testing.
 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Owner's administrative procedures necessary for certification of Substantial Completion.
 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and completion.

- D. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. As the Work progresses, indicate completion percentage for each activity.
- E. Distribution: Distribute copies of approved schedule to Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 REPORTS

- A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- B. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
 - 1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

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

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
 - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

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

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering,

manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

1.5 SUBMITTAL FORMATS

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

1. Project name.
2. Date.
3. Name of Owner.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Submittal purpose and description.
9. Drawing number and detail references, as appropriate.
10. Indication of full or partial submittal.
11. Other necessary identification.
12. Remarks.
13. Signature of transmitter.

B. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Owner on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

C. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Owner.
 - a. Owner will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Owner's receipt of submittal. No extension of the Contract Time authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Owner will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Owner's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Owner's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.

4. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- D. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Owner.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
1. Owner will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 OWNER REVIEW

- A. Action Submittals: Owner will review each submittal, indicate corrections or revisions required, and return it.
1. PDF Submittals: Owner will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Owner will review each submittal and will not return it, or will return it if it does not comply with requirements. Owner will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Owner.

- D. Incomplete submittals are unacceptable, considered nonresponsive, and will be returned for resubmittal without review.
- E. Owner will discard submittals received from sources other than Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Construction Manager.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

1.4 CONFLICTING REQUIREMENTS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.

- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Owner. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Owner has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and re-inspecting.
- B. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- E. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.9 QUALITY CONTROL

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

1. Notify Owner, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

- A. Ground Engineering;
- B. Earth Engineering or Approved Equal.

3.2 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.

4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

3.3 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
2. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
3. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
4. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
5. AIA - American Institute of Architects (The); www.aia.org.
6. ANSI - American National Standards Institute; www.ansi.org.
7. APA - APA - The Engineered Wood Association; www.apawood.org.
8. ASCE - American Society of Civil Engineers; www.asce.org.
9. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
10. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
11. ASSE - American Society of Safety Engineers (The); www.asse.org.
12. ASTM - ASTM International; www.astm.org.
13. AWP - American Wood Protection Association; www.awpa.com.
14. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
15. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
16. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
17. CSI - Construction Specifications Institute (The); www.csinet.org.
18. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
19. FSC - Forest Stewardship Council U.S.; www.fscus.org.
20. GS - Green Seal; www.greenseal.org.
21. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
22. ICC - International Code Council; www.iccsafe.org.
23. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
24. IESNA - Illuminating Engineering Society of North America; (See IES).
25. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
26. ISO - International Organization for Standardization; www.iso.org.
27. LPI - Lightning Protection Institute; www.lightning.org.
28. NCMA - National Concrete Masonry Association; www.ncma.org.
29. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
30. NSPE - National Society of Professional Engineers; www.nspe.org.
31. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
32. TPI - Turfgrass Producers International; www.turfgrasssod.org.
33. USGBC - U.S. Green Building Council; www.usgbc.org.
34. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. ICC - International Code Council; www.iccsafe.org.
 2. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. DOE - Department of Energy; www.energy.gov.
 3. EPA - Environmental Protection Agency; www.epa.gov.
 4. GSA - General Services Administration; www.gsa.gov.
 5. OSHA - Occupational Safety & Health Administration; www.osha.gov.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. FED-STD - Federal Standard; (See FS).
 3. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 4. USAB - United States Access Board; www.access-board.gov.
 5. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation, removal of, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Not available.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, graphic elements, and message content.

- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.5 QUALITY ASSURANCE

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

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

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

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are not needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

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

- B. Water Service: Connect to Owner's existing water service facilities (hydrants). Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
 - 1. Provide dust-control treatment that is non-polluting and non-tracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.

- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

END OF SECTION 015000

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
 - b. Coordination of Work and equipment movement with the locations of protection zones.
 - c. Trenching by hand or with air spade within protection zones.
 - d. Field quality control.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
 - 2. Detail fabrication and assembly of protection-zone fencing and signage.
 - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Samples: For each type of the following:
 - 1. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
 - 2. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.7 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA.

- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

1.8 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Moving or parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements:
 - 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: 72 inches (1800 mm).
 - 2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches (2400 mm) apart.
 - a. Height: 48 inches (1200 mm).

- b. Color: High-visibility orange, nonfading.
- B. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 - 1. Size and Text: 3-inch- (75-mm-) high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 50 feet (15 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.

- D. Maintain protection-zone fencing and signage in good condition as acceptable to Owner and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.

3.5 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
 - 1. Prune to remove only broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
 - 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
 - 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
- B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and spread over areas identified by Owner.

3.6 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

3.7 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Owner.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Owner.
- B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
- C. Soil Aeration: Where directed by Owner, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 2. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Owners Action: If necessary, Owner will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Owner will

notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 2. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 3. Protect stored products from damage and liquids from freezing.
 - 4. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- B. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. Non-restricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 - 3. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Owner will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Owner may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent of area per plan.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
- D. Certified Surveys: Submit two copies signed by land surveyor.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Site Construction Elements: Do not cut and patch site construction elements that results in increased maintenance or decreased operational life or safety.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Owner promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at construction limits and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Owner when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Owner. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Owner before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

- D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 3. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 5. Proceed with patching after construction operations requiring cutting are complete.
- E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Restore damaged pipe covering to its original condition.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Certificate of Insurance: For continuing coverage.
- B. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

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

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 3. Submit testing, adjusting, and balancing records.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 2. Complete final cleaning requirements.
 3. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to the Contract Documents.
 2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 3. Submit pest-control final inspection report.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order.
 2. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Owner
 - d. Name of Contractor.
 - e. Page number.
 3. Submit list of incomplete items in the following format:

- a. PDF electronic file. Owner will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

- c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

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

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Locations and depths of underground utilities.
 - d. Locations of concealed internal utilities.
 - e. Details not on the original Contract Drawings.
 - f. Field records for variable and concealed conditions.
 - g. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Owner. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Owner for resolution.

4. Owner will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Owner.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 3. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.

- C. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

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

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 024100 – DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Demolition, removal, salvage and disposal of existing site features, fences, structures and materials where indicated on the drawings and as specified in this section.
- B. Demolition and removal of concrete foundations, sidewalks, concrete and asphaltic paving

1.2 RELATED SECTIONS

- A. Section 31 00 00 - Earthwork

1.3 SUBMITTALS

- A. Permits and Certificates.
 - 1. Certificates of severance of utility service.
 - 2. Permit for transport and disposal of debris.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division One specifications.
- B. Accurately record actual locations of capped utilities and subsurface obstructions.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and disposal.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct roadways, sidewalks, or hydrants without written permission from Owner.
- E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.6 SCHEDULING

- A. Schedule and submit under provisions of Division One specifications..
- B. Provide detailed descriptions for demolition and removal procedures.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Fill Material: Use on site fill material under provisions of Section 31 00 00.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify areas to be demolished are unoccupied and discontinued in use.
- B. Do not commence work until conditions are acceptable to Owner.

3.2 PREPARATION

- A. Provide, erect, and maintain temporary barriers, enclosures, security fences and shoring at demolition locations in accordance with Division One and other related specifications to protect personnel.
- B. Protect existing structures and utilities which are not to be demolished.
- C. Provide temporary wiring and connections to maintain existing telephone, electrical, instrumentation and control systems in service during construction.
- D. Protect designated trees and plants from damage.
- E. Mark location of existing utilities.

3.3 GENERAL REQUIREMENTS

- A. Sprinkle Work with water to minimize dust where applicable. Provide hoses and water connections for this purpose.
- B. Do not use water to extent causing flooding, contaminated runoff, or icing.
- C. Remove demolished material from the site
- D. Repair damage to adjacent structures.
- E. Remove existing exposed piping and electrical wiring and conduit to be abandoned to structural surface, cut flush, and finish to match existing surfaces.
- F. Remove buried piping, wiring, and conduit to be abandoned as required for the Work. Plug the remainder flush.

3.4 DISPOSAL

- A. Do not store or burn waste materials on-site.
- B. Transport demolition debris to designated off-site disposal area.

3.5 SITE DEMOLITION

- A. Disconnect, remove, cap and identify designated utilities within demolition area.
- B. Remove concrete to nearest joint beyond demolition area.
- C. Remove, salvage or dispose of existing fencing as shown on drawings.
- D. Remove storm sewer items where shown on the drawings.
- E. Backfill areas excavated caused as a result of demolition, in accordance with Section 31 00 00.
- F. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on drawings.
- G. Remove demolished materials from site.
- H. Do not burn or bury materials on site, unless otherwise directed by Owner. Leave site in clean condition.

3.6 ELECTRICAL DEMOLITION

- A. General:
 - 1. Remove, relocate and extend existing installation to accommodate new construction.
- B. Existing electrical service:
 - 1. Electric Service Main: refer to Electric Plans and Specifications.
 - 2. Work by Contractor:
 - a. Provide standby power conduit and cables for temporary use during construction. Completely remove temporary service after new permanent service is installed.
 - b. Remove existing light poles, demo electric service. Refer to Electric Plans and Specifications.

END OF SECTION 024100

SECTION 031000 – CONCRETE FORMWORK

PART 1 GENERAL

1.01 Description

- A. Formwork for cast-in-place concrete shall include shoring for cast-in-place concrete and installation into formwork of items furnished under other Sections, such as anchor bolts, setting plates, bearing plates, anchorages, frames, and accessory items embedded in concrete.

1.02 Related Work

- A. Section 033000 – Cast-In-Place Concrete

1.03 Codes and Standards

- A. Unless otherwise indicated, comply with the American Concrete Institute (ACI) Standard 347, "Recommended Practice for Concrete Formwork."

1.04 Design

- A. Design of formwork, shoring and accessories shall be the responsibility of the Contractor. Design, erect, support and maintain formwork so as to safely support all vertical and lateral loads until such loads can be supported by the concrete structure. Determinations shall be made in accordance with ACI 347.
- B. Forms for concrete surfaces requiring subsequent treatment shall receive a type of coating that will not impair bond or adhesion.
- C. Form oil for steel forms shall be non-staining, rust-preventative type.

PART 2 PRODUCTS

2.01 Forms for Exposed Finish Concrete

- A. Unless otherwise designated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced, or other panel type materials acceptable to the Construction Coordinator, to provide continuous, straight, smooth surfaces. Furnish panels in largest practicable sizes to minimize number of joints. Provide form material of sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

2.02 Plywood

- A. Form plywood shall be Douglas Fir, 5 ply "Plyform," mill treated, edge sealed, water resistant plywood made for the purpose, free of loose knots, splits, checks, or excessive raised grain.

2.03 Ties

- A. Ties shall have a minimum working strength of 3,000 lbs when fully assembled. Ties shall be adjustable to permit tightening of forms. Ties shall leave no metal closer to the surface than 1-1/2 inch nor create a hole larger than 7/8 inch in diameter. Wire or bank iron ties are not permitted.

2.04 Chamfer Strips

- A. Three-fourths inch by three-fourths inch by 45° wood, plastic, or rubber stripping.

2.05 Form Coating Compound

- A. Form Coating Compound shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces and not impede the wetting of surfaces to be cured with water or curing compounds.
- B. Forms for concrete surfaces requiring subsequent treatment shall receive a type of coating that will not impair bond or adhesion.
- C. Form oil for steel forms shall be non-staining, rust-preventative type.

PART 3 EXECUTION

3.01 Construction

- A. Construct forms to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb in finished construction. Provide for openings, offsets, sinkages, recessed, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Forms shall be sufficiently tight to prevent leakage of concrete. Assemble forms so their removal will not damage concrete.
- B. Chamfer all corners of concrete exposed to view.

3.02 Form Coatings

- A. Coat form contact surfaces with form coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.03 Provision for Other Trades

- A. Provide openings in concrete formwork to accommodate work of other trades, including those under separate prime contracts (if any). Size and location of openings, recesses and chases are the responsibility of the trade requiring them. Accurately place and securely support items built into forms.

3.04 Cleanouts, Cleaning, and Tightening

- A. Provide temporary openings in wall and column forms as required to facilitate cleaning and inspections. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris immediately before concrete is to be placed.
- B. Tighten form immediately after concrete placement as required to eliminate mortar leaks.

3.05 Removal of Forms

- A. Remove forms from cast-in-place concrete only after concrete has achieved sufficient strength to support itself and superimposed loads, but in no case in less time than stated below.
- B. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed 24 hours after placing concrete provided concrete is sufficiently hard to not be damaged by form removal operations, and provided that curing and protection operations are maintained.
- C. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements shall not be removed until concrete has attained minimum 28-day compressive strength, but not less than 14 days.
- D. Form-facing materials may be removed 4 days after placement, if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.06 Re-Use of Forms

- A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for the new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for concrete surfaces exposed to view.

END OF SECTION

SECTION 032000 – CONCRETE REINFORCING

PART 1 GENERAL

1.01 Summary

- A. Provide concrete reinforcement including bars, welded wire fabric, ties, and supports as shown and as specified. Comply with applicable provisions of Div. 0 and 1.

1.02 Related Sections

- A. Section 031000 - Concrete Formwork
- B. Section 033000 - Cast-in-Place Concrete

1.03 Codes & Standards

- A. Comply with provisions of following codes and standards, except as otherwise designated:
 - 1. ACI 315 Details and Detailing of Concrete Reinforcement.
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete.
 - 3. AWS D1.4 Structural Welding Code-Reinforcing Steel.
 - 4. CRSI Manual of Standard Practice.

1.04 Submittals

- A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315. Show bar schedules, stirrup spacing, diagrams of bent bars, and arrangements and assemblies of concrete reinforcement. Include special reinforcement required at openings through concrete structures.
- B. Make submittals in accordance with Section 013300.

1.05 Quality Assurance

- A. Notify Construction Coordinator 24 hours prior to concrete placement to permit review of reinforcement.

1.06 Delivery & Storage

- A. Deliver reinforcement bundled and marked using metal tags corresponding to placement diagrams. Store concrete reinforcement to prevent damage and accumulation of dirt or excessive rust.

PART 2 PRODUCTS

2.01 Reinforcing Bars

- A. ASTM A615, Grade 60, deformed, new billet steel.

2.02 Welded Wire Fabric (WWF)

- A. ASTM A185, welded steel wire fabric.

2.03 Supports for Reinforcement

- A. Furnish bolsters, chairs, spacers, hangers, and other devices for spacing, supporting and fastening reinforcement in place. Use wire bar type supports complying with CRSI specifications, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.
- B. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs.
- C. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
- D. For sandblasted, bush-hammered, and tooled concrete, provide stainless steel accessories.
- E. Over waterproof membranes, use precast concrete chairs to prevent penetration of membrane.

2.04 Fabrication

- A. Shop-fabricate reinforcing bars to conform to required shapes and dimensions; comply with fabrication tolerances of ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken material. Reinforcement with the following defects will not be permitted:
 - 1. Bar exceeding specified fabrication tolerances.
 - 2. Bend or kinks not indicated on Drawings or final shop drawings.
 - 3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 EXECUTION

3.01 Placing Reinforcement

- A. Comply with specified codes and standards, and CRSI recommendations.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which interfere with bond to concrete.

- C. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing with metal chairs, runners, bolsters, spacers, and hangers, as required to carry reinforcement.
- D. Provide a minimum center-to-center spacing of 2-1/2 bar diameters and a minimum clear spacing between bars 1-1/2 times maximum aggregate size. Place reinforcement to obtain minimum concrete coverages specified below.
- E. Securely tie bars and bar supports together with 16 gage annealed iron wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed away from exposed concrete surfaces. Do not place reinforcing bars more than 2" beyond last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

3.02 Placing Fabric

- A. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh, but not less than 6" on side joints and 12" on end joints; lace splices with 16 gage annealed iron wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 Splices & Terminations

- A. Comply with requirements of ACI 318, CRSI, and as shown.
- B. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
- C. Splices and laps indicated in reinforcement for beams, columns, elevated slabs, and walls shall be 30 bar diameters minimum, unless otherwise noted. Stagger adjacent laps and splices, unless otherwise shown.
- D. Horizontal reinforcement in footings, foundations and walls at corners and intersections shall be made continuous using corner bars or "L" dowels of same diameter; lap 30 bar diameters, unless otherwise shown.
- E. Splices for horizontal wall reinforcement of circular tanks shall be staggered so that no more than each fifth bar is spliced within any two feet of wall perimeter.
- F. Splices not shown on Drawings or shop drawings shall be determined on basis of safe bond stress and stress in reinforcement; splices shall not be less than 24 bar diameters and minimum 12" length.
- G. Terminate horizontal reinforcement in beams, elevated slabs and walls with a standard hook, unless otherwise shown.
- H. Rebar splicing devices and anchorage systems, such as inserts in lieu of continuous bars to facilitate gang forming, will be allowed provided strength capacities are equal to rebar they replace. Submit details for approval before installation.

3.04 Concrete Cover

- A. Provide the following minimum concrete cover over steel reinforcement, unless otherwise shown:

Footings:	3"
Foundation walls:	2"
Tank walls:	2"
Walls exposed to earth:	2"
Walls to dry interior spaces:	1"
Beams, interior:	1-1/2"
Columns, interior:	1-1/2"
Slabs-on-grade, bottom:	3"
Slabs, surfaces exposed to dry interior spaces:	3/4"
Slabs exposed to water & wastewater:	2"

3.05 Grouting Reinforcement Bars

- A. Where shown, drill and grout reinforcement bars into existing concrete. Use pre-mixed non-shrink grout or expansive portland cement grout consisting of two parts sand, one part portland cement, and unpolished aluminum powder at rate of 4 grams per sack of cement, thoroughly dry mixed with cement. Grout shall be mixed as dry as practicable. Fill hole with grout and ram reinforcement bar into place. Remove excess grout from surface area. Proprietary non-shrink grout products shall be submitted for approval.

END OF SECTION

SECTION 033000 – CAST IN PLACE CONCRETE

PART 1 GENERAL

1.01 Section Includes

- A. Portland cement concrete shall be composed of a mixture of an air entraining agent, Portland cement, fine and coarse aggregates, and water, proportioned to produce a workable, strong, dense, and impermeable concrete. Admixtures may be added to achieve a desired result provided such admixture does not adversely affect strength and durability of the concrete.

1.02 Related Work

- A. Section 023210 - Trenching, Backfilling, and Compacting
- B. Section 025010 - Manholes
- C. Section 027010 - Pavement Replacement
- D. Section 031000 - Concrete Formwork
- E. Section 032000 - Concrete Reinforcement
- F. Section 032530 - Waterstop

1.03 Submittals

- A. Prepare mix design and prove with laboratory 7-day and 28-day compressive tests, or submit test reports of 7-day and 28-day compressive tests of the mix where the same mix has been used on two previous projects. Submit mix design in writing for review by the Owner at least 15 days before placing any concrete.

The compressive strength of the laboratory trial mix shall be at least 25 percent greater than the desired 28 day field compressive strength.

- B. Provide certificate that cement complies with ASTM C150 Standard Specifications for Portland Cement and these specifications.
- C. Provide certificate that aggregates comply with ASTM C33 Standard Specifications for Concrete Aggregates. State weathering region limits of coarse aggregates: severe, moderate, or negligible. State abrasion resistance in percent loss as measured per ASTM C131. State basis of determining that potential reactivity is negligible.
- D. For Ready Mix Concrete: Provide delivery tickets or weighmasters' certificate per ASTM C94, including weights of cement and each size aggregate, amount of water in the aggregate, and amount of water added at the plant. Write in the amount of water added on the job.
- E. For concrete admixtures, provide manufacturer's certificate of compliance with these specifications.

- F. Epoxy Bonding Compound: Provide manufacturer's specific instructions for use.
- G. Non-shrink Grout: Provide manufacturer's certificate of compliance with these specifications and specific instructions for use.

1.04 Inspection

- A. Prior to placing concrete, the Contractor shall notify the Construction Coordinator for inspection of surface preparation and the placement of reinforcement steel.

1.05 Weather Limitations

- A. Cold weather concreting procedures shall be provided as recommended in the ACI Manual of Concrete Practice, except as noted below. Except when authorized by the Construction Coordinator, concreting operations shall not be continued when a descending air temperature in the shade, away from artificial heat, falls below 40 degrees Fahrenheit nor resumed until an ascending air temperature in the shade, away from artificial heat, reaches 35 degrees Fahrenheit. Curing of slabs on grade and footings may be omitted during the season of the year when freezing temperatures can be expected or when the atmospheric temperature may be expected to drop below 40 degrees Fahrenheit during the required protection period following the placement of concrete, provided that the newly laid concrete shall be protected by covering with a layer of impermeable paper or plastic and covered with not less than 12 inches of loose, dry hay or straw. Plastic sheathed, insulated blankets are approved equals for the insulating layers of plastic and hay. The covering shall be retained in place for a period of ten days.
- B. Neither calcium chloride or chemical admixtures shall be added to the concrete to prevent freezing.
- C. The Contractor shall employ effective means, such as precooling of aggregates and mixing water and placing at night, as necessary, to maintain the temperature of the concrete, as it is placed, below 90°F. This shall be accomplished in accordance with recommendations for hot weather concreting given in detail in "Hot Weather Concreting" reported by ACI Committee 305.

PART 2 PRODUCTS

2.01 Cement

- A. Use Portland cement, ASTM C150, Type I or II, unless otherwise specified, and when high early strength concrete is specified, use Type III. Type II Portland cement shall be used during warm weather conditions as directed by the Construction Coordinator in accordance with the ACI recommended installation practices.

2.02 Synthetic Fibers

- A. When Drawings designate fibermesh concrete, mix synthetic fiberglass fibers into concrete such as Harbourite, manufactured by Fibermesh Incorporated, Chattanooga, Tennessee, or approved equal according to manufacturer's specifications. The amount of synthetic fibers added to the concrete shall be 1.5 pounds per cubic yard of concrete.

2.03 Aggregates

- A. Fine and coarse aggregates shall comply with ASTM C33 Standard Specification for Coarse Aggregates. Aggregate shall consist of clean, hard, durable sand, crushed rock, and crushed gravel, or gravel. Coarse aggregate shall meet the grading requirements for size number 67, or 57 Colorado Standard Specifications for Road and Bridge Construction. The maximum aggregate size for riprap grout shall be 3/8 inch.
- B. Ratio of coarse aggregate to fine aggregate shall not be less than 1:1 nor more than 2:1.

2.04 Water

- A. Mixing water shall be free of oil, acid, excessive alkalinity, organic matter, salts, or other impurities.

2.05 Admixtures

- A. Use admixtures when specified or with express permission of the Construction Coordinator, in strict accordance with the manufacturer's instructions. Exercise care to assure that the admixture does not increase or decrease the air content beyond the allowable limits.
- B. Air entraining agent shall be Master Builders, MB-AE10; W.R. Grace and Co., Dara Vair, or approved equal. The added air entraining agent shall produce, in accordance with ASTM C260, an entrained air content as specified in Table 601-1 of Colorado Standard Specifications for Road and Bridge Construction.

2.06 Concrete Mixture

- A. Use the following classes of concrete, if not otherwise indicated, as described in the Standard Specifications for Road and Bridge Construction (CDOT 1999), and as modified herein.

<u>Concrete Class</u>	<u>Use</u>	<u>Modifications</u>
Design Strength		
A	Use Class B Concrete	
B - 3,000 psi	All concrete 12-inch or less thick. (May substitute class D).	none

D - 4,500 psi	As specifically called out by structure or concrete greater than 12-inches thick.	none
P - 4,200 psi	Concrete pavement.	none

Additional modifications and mixture specifications are given in Section 01010. Class D concrete requires the use of an approved water reducing mixture.

2.07 Riprap Grout Mixture

- A. 2,000 psi
 Min 6 sacks total cementitious material/per cubic yard
 Up to 25 percent flyash substitution, Class C or F*
 Type II cement
 70 percent Type I granular bedding, 3/8-inch gravel
 7-inch \pm 2-inch slump
 1.5 lb fibermesh or equivalent per cubic yard concrete as required by Construction Coordinator
 (Max 3/4-inch fiber length)
 7-1/2 percent \pm 1-1/2 percent air entrainment
 *Class F when high sulfate content in soil

PART 3 EXECUTION

3.01 Preparation

- A. Surfaces which will be in contact with the new concrete shall be prepared as follows:
 1. Forms shall be wetted with light oil.
 2. Subgrade shall be sprinkled with water.
 3. Old concrete and adjacent structures shall be separated from new concrete with 3/4-inch asphalt-impregnated felt (performed expansion joint filler) as specified below.
 4. All reinforcement steel shall be positioned to provide a minimum of one and one-half (1-1/2) inch concrete cover except as noted otherwise on the Drawings.

3.02 Joints

- A. Preformed joint filler shall be furnished. Damaged or repaired joint filler shall not be used unless approved by the Construction Coordinator. The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing concrete. Finished joints shall not deviate more than 1/4-inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. Plugs of concrete shall not be permitted anywhere within the expansion space. Expansion joints shall be formed at all existing or proposed structures and features projecting through, into or against the

concrete work. When expansion joint details are not shown on the Drawings, the Contractor shall form the joint in conformance with good construction practice, and furnish all expansion joint materials.

B. Construction Joints

1. Concrete in each unit of construction shall be placed continuously. Before new concrete is placed on or against concrete which has set, forms shall be retightened and the surface of the set concrete shall be cleaned of foreign matter. Watertight joints shall be provided with waterstop as specified in Section 03253.
2. Construction joints shall be formed as specified below. A rough surface of exposed concrete aggregates shall be produced using a surface retardant at construction joints, including joints between slab and grout. The limit of the treated surfaces shall be 1 inch away from the joint edges. Within 24 hours after placing, retarded surface mortar shall be removed either by high pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregates. A rough surface of exposed aggregate may also be produced by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/8 inch of laitance film and shall expose coarse aggregate to insure adequate bond and watertightness at the construction joints.

After cleaning and before new concrete is placed, vertical joints shall be thoroughly wetted. After cleaning, and immediately prior to placement of concrete in walls, the construction joint at the base of the wall shall be slushed with one two inches of neat cement grout. The neat cement grout shall be formulated with water and cement only, shall have a water/cement ration less than or equal to that of the concrete and a consistency similar to thick paint. The fresh concrete shall be placed before the grout has attained its initial set.

3.03 Inserts and Embedments

- A. Where pipes, castings, or conduits pass through structures, the Contractor shall place such pipes or castings in the forms before placing the concrete, or he may provide openings in the concrete for subsequent insertion of such pipes, castings, or conduits with approval of the Construction Coordinator. Such openings shall be provided with waterstops and a V-shaped construction joint and shall have a slight flare to facilitate grouting and permit the escape of entrained air during grouting. Additional reinforcement shall be provided around large openings as shown in the Drawings. The grout shall be as specified herein.
- B. Gate frames, gate thimbles, special castings, channels, or other miscellaneous metal parts that are to be embedded in the concrete shall be set and secured in the forms prior to concrete placement. Unless otherwise specified, anchor bolts and inserts shall be embedded in concrete and bedrock as shown. The Contractor shall provide inserts, anchors, or other bolts necessary for the attachment of piping, valves, metal parts, and equipment. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removal material to prevent the entry of concrete into the voids. Operators or sleeves for gate or valve stems shall be positioned to clear reinforcing steel, conduit and other embedments, and to align accurately with equipment.

3.04 Mixing Concrete

- A. If "Ready-mix" concrete is used, it shall be produced, delivered, and handled in accordance with the requirements of the State of Colorado Standard Specifications for Road and Bridge Construction.
- B. Concrete shall be deposited at the job site within one hour after introduction of water in the mix. Care shall be taken in transferring concrete from the truck or mixer to avoid segregation of aggregates in the mixture.

3.05 Field Quality Control

- A. Contractor shall conduct tests on the proposed concrete mixture to determine the slump, entrained air content, compressive strength, or other appropriate tests to determine conformance with these specifications.
- B. The Construction Coordinator may elect to have slump tests taken prior to concrete placement. Testing will be done by the Contractor or his representative. Failure to meet the limits established for slump may result in rejection of the load.
- C. The concrete shall be subjected to compressive strength tests. The Contractor shall supply standard test cylinders and the Contractor or his representative may fill the cylinders. Two cylinders for compressive strength tests at 7 days and 28 days shall be cast for each test. One test may be required for each daily pour of 25 cubic yards of concrete or more or for a single structure that requires less than 25 cubic yards.
- D. Test procedures shall conform to ASTM C31, C39, C143, and C172 specification standards as applicable.
- E. The Contractor will arrange to have the cylinders tested by an approved laboratory.
- F. Should the Construction Coordinator consider it necessary, Standard Proctor and field density tests will be required to determine adequacy of compaction of subgrade or base materials, as specified in Section 02321 or 02701.
- G. All tests shall be taken under the supervision of the Construction Coordinator or Inspector. The cost of the test, including materials, transportation, and reports shall be paid for by the Contractor.

3.06 Placing Concrete

- A. The concrete shall be deposited on the subgrade in a manner requiring as little rehandling as possible. Necessary hand spreading shall be done with shovels; rakes are not permitted. Workers shall not work in the green concrete with boots coated with earth.
- B. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. In case of a temporary shutdown, the concrete at the unfinished end of slabs shall be covered with wet burlap. When delays are necessary and of such length so that the concrete deposited will attain its initial set, and in any event where interruption in the concrete placing operations of more than 30 minutes occurs, a joint shall be provided

and installed.

- C. Batches shall be dumped so that the concrete will not displace or disarrange the joint installations. The concrete shall be shoveled into place against the expansion joints and against or around other preassembled joint installations, which might otherwise be displaced or disarranged by concrete flowing against them. The concrete shall be placed against both sides of intermediate joint installations simultaneously.
- D. Sufficient spading, rodding, or mechanical vibrating shall be provided to insure concrete flow into the smallest corners, under pipes, and all places where concrete will not readily flow. Watertightness and an absence of honeycomb is essential for acceptance.
- E. Concrete shall not be placed around castings, frames, joints, and other embedded fixtures until they have been accurately adjusted and set to the required alignment and grades. Paint castings, frames, and embedded metal fixtures on their contact surface with a heavy coat of asphaltic mastic or separate with expansion joint material prior to the placement of concrete.

3.07 Placing Grout

- A. Placement shall conform to ASTM 304 as modified by these specifications.
- B. Pump grout near its final position to avoid segregation caused by rehandling or flowing. The use of a low pressure grout pump for filling voids, such as with grouted riprap is required. Do not deposit concrete in large quantities in one place to be worked along the riprap with vibrator.
- C. Use mechanical vibration when placing grout to eliminate pockets and voids, to consolidate each layer with that previously placed, and to bring just enough fine material to exposed surfaces to produce a smooth, dense, and even texture. Vibrators shall be of the high frequency internal type, and the number in use shall be ample to consolidate the incoming grout to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least two vibrators shall be available at the site.
- D. Do not place grout during rain or snow. Protect grout placed immediately before rain or snow to prevent water from coming in contact with the wet grout. Keep sufficient protective covering on hand at all times for this purpose.

3.08 Formed Surface Finishes

- A. Surface defects, including tie holes, minor honeycombing, or otherwise defective concrete shall be repaired in accordance with ACI 301, Chapter 9. Areas exhibiting unconsolidated concrete shall be brought to the attention of the Construction Coordinator prior to the start of patching. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1 inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Patches shall be cured as specified for the concrete. Finished surfaces shall be protected from stains and abrasions. Finishes shall be equal in workmanship, texture, and general appearance to that of the adjacent concrete. Concrete with honeycombing which exposes the reinforcing steel or with defects which

affect structural strength or impermeability shall be corrected or replaced as directed by the Construction Coordinator.

- B. Formed surfaces shall be finished as soon as practicable after form removal and repair of surface defects. Finishes shall be as follows:

1. FINISH A: Finish A shall be a grout clean finish in accordance with ACI 301, Section 10.3.2. Surfaces shall be lightly sandblasted prior to sacking. Finish A shall be provided for painted and unpainted surfaces, structures immersed in water from 1 foot below minimum water surfaces and up, and permanently exposed vertical and sloped surfaces, such as bridge piers and abutments.

Surfaces subjected to high water velocities of 40 fps or more must have accurate alignment and an even surface to prevent destructive water effects on adjacent surfaces. Such surfaces include outlets, draft tubes, surfaces of outlet works downstream from gates and spillway tunnels of dams. The forms must be strong and held rigidly and accurately to the required alignment and shape with less than 1/4-inch maximum irregularity allowance for projections and zero allowance for depressions. Abrupt irregularities on Finish A in high velocity flow areas of 1/4-inch or less shall be ground smooth in the direction of flow. No abrupt irregularities on these surfaces is greater than the maximum allowable 1/4-inch, the irregularity shall be ground to conform to the allowable limitation, with a maximum grinding height removal allowance of 1/4-inch. All grinding shall bevel irregularities to a 1:20 ratio of height to length and shall not be steeper than the allowed bevel. No abrupt irregularities shall exceed 1/8-inch in any direction not parallel to the direction of flow. If any irregularity exceeds the 1/8-inch limitation, the entire irregularity shall be eliminated by grinding on a bevel of 1:20 ratio of height to length.

2. FINISH B: Finish B shall be referred to as a finish which has surface imperfections less than 3/8-inch in any dimension. Surface imperfections greater than 3/8-inch shall be repaired or removed and the affected areas neatly patched. Finish B or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.

3. FINISH C: Finish C shall be the finish for surfaces which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2-inch in any dimension shall be repaired.

3.09 Slab Finishing

- A. The surface of the concrete shall be thoroughly floated after the concrete has been struck off.
- B. Walks, ramps, pavements, operator platforms, curb and gutter, and driveways shall have a lightly broomed surface with the grain perpendicular to the direction of travel.
- C. Edges shall be neatly trimmed with a 1/4-inch radius edging tool. Any honeycombed areas shall be pointed with mortar.

3.10 Curing

- A. All exposed concrete slabs and formed structures above grade shall have provisions to prevent loss of moisture for at least 24 hours after placement. Methods may include plastic sheets, constant wetting of the surface with water, curing paper, or by use of an approved commercial curing compound and application methods in accordance with procedures designated in ACI 318 and ASTM C309. The rate of application shall be not more than 200 square feet per gallon of compound and in accordance with manufacturer's recommendations.
- B. All grout shall be sprayed with clear curing compound.

3.11 Watertightness, Testing, and Repair

- A. Selected structures as specifically identified elsewhere are subject to hydrostatic pressure and shall be tested for watertightness. The tests shall be made after all piping connections are completed and any gates are operational and closed, and prior to backfilling. Testing shall consist of filling with water to the maximum operating water surface for at least 24 hours. Wet spots, leakage, or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by either or both of the following methods:
 - 1. Grouting of the joint by drilling grout holes to the affected crack or honeycombed area, installing injection ports and forcing epoxy grout into the joint under pressure.
 - 2. Cutting of a bevel groove on the water side of the joint. The groove shall be 1/2- to 3/4-inch in width and depth and shall be caulked with epoxy joint sealer in accordance with manufacturer's instructions.
- B. Long sections of completed pipe to be backfilled may be pressure tested if acceptable to the Construction Coordinator, so that backfilling may proceed concurrently with concrete construction.
- C. The Contractor shall retest items which have been repaired to check the suitability of repairs. Water required for the testing and retesting shall be provided by the Contractor and disposed of so as not to create a nuisance.
- D. It shall be the responsibility of the Contractor to repair or replace damaged concrete to perform the same design functions as originally intended (i.e., structural, directional, aesthetic appearance).
- E. No repair shall be made without prior approval from the Construction Coordinator. Due to the possible variations in repairs needed and function of the structure no further direction is given for repair; careful quality control of design mix, placement, formwork, and finishing is considered the most satisfactory alternative to concrete repair work. Replacement of the repaired concrete may be required if performance is unsatisfactory.

3.12 Cleanup

- A. Upon completion of the work and prior to final inspection, the Contractor shall clean all concrete surfaces. The cleaning procedures shall be as follows: After sweeping with an ordinary broom to remove the loose dirt, the surface shall be flushed with clean water. Final scrubbing by hand or machine shall follow.

END OF SECTION

SECTION 034200 – PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All precast vaults including precast inlets and manholes complete with steps, ring and cover as required
- B. All other necessary appurtenances

1.2 RELATED SECTIONS

- A. Section 03 00 00 – Concrete
- B. Section 33 10 00 – Water Utilities
- C. Section 33 33 00 – Sanitary Sewer Utilities
- D. Section 33 40 00 – Storm Drainage Utilities

1.3 REFERENCES

- A. ASTM A48 - Gray Iron Castings
- B. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- C. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. ASTM C33 - Concrete Aggregates
- E. ASTM C150 - Portland Cement
- F. ASTM C478 - Precast Reinforced Concrete Manhole Sections
- G. City of Loveland construction specifications, standards and details.

1.4 SUBMITTALS

- A. Submit under provisions of Division One Specifications
- B. Shop Drawings: Provide sufficient data to verify compliance with the specifications and to illustrate construction and assembly
- C. Product Data: Provide manufacturer catalog information on castings, grating, and accessories to indicate compliance with specifications
- D. Design Data: Include calculations prepared by precast manufacturer indicating design loads and material requirements for reinforcement

1.5 DELIVERY, STORAGE AND HANDLING

- A. Transport and handle precast concrete units with equipment to protect from dirt and damage
- B. Do not place units in position which will cause damage
- C. Handle by means of lifting inserts
- D. Do not move from manufacturer's yard until curing is complete

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Oldcastle Precast
- B. Or accepted substitution

2.2 MATERIALS

- A. Reinforcement
 - 1. Reinforcing Steel: ASTM A615 Grade 60
 - 2. Welded Wire Fabric: ASTM A185
- B. Concrete: Refer to Division Three Specifications
 - 1. Minimum compressive strength: 4000 psi at 28 days
 - 2. Cement: ASTM C150, Portland Cement, Type II
 - 3. Aggregates: ASTM C33, free of deleterious substances
- C. Precast Sections
 - 1. Specification: ASTM C478
 - 2. Minimum wall thickness: 6 inch
 - 3. Grade rings as required
- D. Gaskets: ASTM C923
 - 1. Mastic: FS SS-S-210A, "RAM-NEK" or accepted substitution
 - 2. Rubber: Neoprene, 40 \pm 5 hardness when measured by ASTM D2240, Type A durometer
- E. Castings: ASTM A48 with asphalt varnish coating hot dip applied at foundry, 6 mils thick
- F. Manhole Steps: Steel bar, 1/2 inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF" or accepted substitution
- G. Inlet Gratings and Manhole Ring and Cover

1. Cast iron, heavy duty traffic type, ASTM A48, Class 30B. Grind bearing surfaces to ensure flat, true surfaces
2. Covers to seat at all points on ring

H. Manhole Height Adjustment: Use precast concrete grade rings

I. Rock Subbase: 1-1/2 inch minus, well-graded gravel over compacted subgrade

J. Water: Clean and free of deleterious substances

2.3 FABRICATION

A. Vault Section

1. Precast concrete dimensions as shown on plans
2. Precast lid: Same or greater reinforcement and wall thickness with capability for H2O loading
3. Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
4. Access opening: Minimum 24 clear
5. Pipe connection: As indicated on Drawings
6. Pipe knockout: As indicated on Drawings

B. Grating and Metal Frame: As specified on drawings

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located
- B. Verify that built-in items are in proper location, ready for roughing into Work
- C. Verify excavation for vault is correct

3.2 PREPARATION

A. Excavation, Backfill, Subgrade Compaction: Refer to Section 31 00 00 for requirements

B. Rock Subbase

1. Remove water and place 6 inch minimum depth
2. Vibrate for compaction
3. Level top to accept precast sections with uniform bearing all around
4. If material below vault is unsuitable, excavate as directed by the Engineer and backfill to grade with 1-1/2 inch minus rock and compact

3.3 PLACING PRECAST SECTIONS

A. Thoroughly clean joints of sections to place gasket material

- B. Place gasket material on base or lower section to ensure watertight fit between lower precast section and upper precast section
- C. Fill inside and outside of joint completely with non-shrink grout and trowel smooth
- D. Cure non-shrink grout using approved methods as recommended by manufacturer

3.4 PREFORMED GASKETS

- A. Remove and replace vault sections which have chipped or cracked joints
- B. Thoroughly clean section joints
- C. Install gasket in conformance with manufacturer's recommendations
- D. Only use primer furnished by gasket manufacturer

3.5 MANHOLE RING AND COVER

- A. Place ring in bed of non-shrink grout on top of vault
- B. Carry non-shrink grout over flange of ring
- C. Set top of ring flush with all surfaces subject to foot and vehicular traffic
- D. Use precast grade rings for height adjustment

END OF SECTION 034200

SECTION 048100 – UNIT MASONRY ASSEMBLY

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMU).
 - 2. Stone accents.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- C. Physical samples for each type, texture and color of exposed masonry unit and colored mortar.
- D. Physical sample of stone.
- E. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.
 - 1. For masonry units include material test reports substantiating compliance with requirements.
- F. Mix Designs: For each type of mortar and grout, include description of type and proportions of ingredients.
- G. Preconstruction testing: Submit recent tests of the following:
 - 1. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
 - 2. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.

1.03 QUALITY ASSURANCE

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.
 - 1. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
 - 2. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
 - 3. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.
 - 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high.

1.04 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1 / ASCE 6/TMS 602 Section 2104.3 in the International Building Code.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1 / ASCE 6/TMS 602.
- C. Moisture Protection During Installation: Where exposed to weather, cover top of masonry walls at the end of each day's work using a waterproof material weighted down to ensure its remaining in place. Maintain such protection until final capping of wall.

PART 2 – PRODUCTS

2.01 COLORS, TEXTURES AND PATTERNS

- A. Exposed Masonry Units: As selected from manufacturer's full range.
- B. Colors will be selected by Architect after manufacturer is determined.

2.02 CONCRETE MASONRY UNITS (CMU)

- A. Provide hollow, load-bearing blocks conforming to ASTM C90, Type I, lightweight, minimum compressive strength 2000 psi at 28 days, cured not less than 28 days at time of delivery.
- B. Provide block with minimal dimensions of 4", 6" or 8" thick x 8" x 16" face, as indicated.
- C. Provide starter block, half blocks, lintels, bond beams, sills, or other special shapes indicated or required.
- D. Manufacturer: "Claylight" or approved equal.

2.03 CONCRETE AND MASONRY LINTELS

- A. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Refer to Drawings for required aesthetic appearance of bond beams.

2.04 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 270 Type S.
- C. Aggregate for Grout: ASTM C 404.
- D. Cold-Weather Admixture: Non-chloride, non-corrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:
 - a. Addiment Incorporated; Mortar Kick.
 - b. Euclid Chemical Company (The); Accelguard 80.
 - c. Grace Construction Products, a unit of W.R. Grace & Co. – Conn.; Morset.
 - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
 - e. Approved substitute.

E. Water: Potable.

F. Mortar shall be Type S.

2.05 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.
 1. Wire Size for Side Rods: W1.7 or 0.148 inch diameter.
 2. Wire Size for Cross Rods: W1.7 or 0.148 inch diameter.
 3. Wire Size for Veneer Ties: W2.8 or 0.188 inch diameter.
 4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 5. Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.06 TIES AND ANCHORS

- A. Materials:
 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8 inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 1. Wire: Fabricate from 3/16 inch diameter, hot-dip galvanized steel wire.
- D. Partition Top Anchors: 0.097 inch thick metal plate with 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1 ½ inches wide by ¼ inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.
 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.07 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 7 Section "Sheet Metal Flashing and Trim."

- B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:
 - 1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester reinforced ethylene interpolymer allow 0.025 inch thick, with a 0.015 inch thick coating of rubberized-asphalt adhesive.
- C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."
- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.08 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use one of the following, unless otherwise indicated:
 - 1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 x 1 1/2 x 3 1/2 inches long.
 - 2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

2.09 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.
 - d. Approved substitute.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixture, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar for exterior and reinforced masonry to Portland cement and lime.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASMT c 270, BIA Technical Notes 8A, IBC Standard 21-15, Proportion Specification.

1. For masonry below grade or in contact with earth, use Type S.
 2. For reinforced masonry, use Type S.
 3. For mortar parge coats, use Type S or N.
 4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
 5. For interior non-load-bearing partitions, Type N may be used instead of Type S.
- C. Grout for Unit Masonry: Comply with ASTM C 476 IBC Standard 21-19.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 Table 21-C in the Uniform Building Code for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.11 MASONRY SEALER

- A. Anti-graffiti sealer for exterior unit masonry:
1. Refer to Division 9, Section 9910 for sealer and manufacturers.

2.12 INSULATION FILL

- A. Loose granular insulation fill.

2.13 STONE

- A. Loveland buff sandstone accents; sizes per drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.02 PREPARATION

- A. Layout:
1. Lay-out masonry in advance before setting to determine bond pattern, jointing and cutting; to minimize jumping bond; and to obtain uniformity in appearance of exposed work.
 2. Make and utilize story-pole for establishing vertical coursing. Determine vertical dimensions by use of story pole. Vertical joints shall be in bond alignment.

3.03 INSTALLATION

- A. General:
1. Lay units with horizontal and vertical joints equal size, plumb and in line; with surface of exposed work in one plane.
 2. Do not place cracked, chipped, or otherwise damaged units in exposed-to-view areas; units thus placed are subject to rejection and replacement.

- B. Wetting:
 - 1. Wet masonry units with absorption rates in excess of 30 g/30 in ²/minute, as determined by ASTM C67, so that rate of absorption when laid does not exceed this rate.
 - 2. Wet masonry units the day before laying by hose until nearly saturated or until water begins to run from pile or pallet. In extremely dry weather, it may be necessary to wet masonry units several hours in advance of use.
 - 3. Allow units to absorb the water so they are damp but not wet at the time of laying.
- C. Cutting: Cut units with masonry saw where cuts will be exposed.
- D. Laying:
 - 1. Hollow Units:
 - a. Lay with mortar on face shells only except bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 - b. At starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
 - c. Spread enough mortar on bed and head joints to cause mortar to ooze out on both faces of joints. Lay cored units with thicker end of face shell up. Do not slush cores except where specifically indicated.
 - 2. Solid Units:
 - a. Lay solid units with full head and bed joints. Butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
 - 3. Joining: Where fresh masonry joins masonry which has totally or partially set, clean and lightly wet exposed surface of set masonry.
- E. Bond: Unless special bond is indicated, lay masonry units in running bond with head joints aligned vertically and bonded ½ unit length generally, but never less than 2: nominal.
- F. Coursing: CMU: Three courses in 24" vertically.
- G. Joints: Unless otherwise indicated, tool exposed-to-view horizontal and vertical joints with concave rod tool. Strike non-exposed, interior joints flush.
- H. Built-in Work:
 - 1. Build-in required chases, openings, lintels, sheet metal, accessories, ties, anchors, sleeves, flashings, pipe, and conduit furnished by other trades to be built into masonry work.
 - 2. Fit around built-in items in exposed masonry surfaces in a manner that surrounding joints will not be wider than 3/8" if no cover plate is used. If cover plate is used, cover entire joint by plate.
- I. Control Joints:
 - 1. Provide control joints in masonry walls where shown or at a maximum of 30'-0" o.c.
 - 2. Install pre-formed rubber or PVC control joints in masonry as work progresses. Install compressible filler at masonry walls abutting structural members.
 - 3. Maintain control joints of uniform width, plumb vertically, clean and free of mortar, ready for installation of sealant.
- J. Lintels: Provide reinforced masonry lintels over all openings in masonry work.
 - 1. Reinforced Block Lintels:

- a. Reinforced concrete filled block, of same thickness and surface texture as wall, or steel as shown; designed for load and span. Provide 8" minimum bearing at each end. A lintel is required over each opening in block work.
- b. For exposed work, match color and texture of block and furnish in lengths to lie up with end joint coursing beyond openings or jambs. Reinforce with deformed rods.

K. Flashings:

- 1. Install through-wall or built-in flashing in exterior masonry walls at the following locations:
 - a. Bottom of walls or wall-to-floor intersections
 - b. Door and window heads or other lintels
 - c. Window sills
- 2. If rubberized asphalt sheet flashings are used or allowed, prime masonry and concrete surfaces as recommended by the manufacturer prior to application of the rubberized asphalt sheet flashings.
- 3. Install flashings in continuous runs of longest practical lengths. Lap seams and joints 4" minimum and seal with non-hardening mastic or sealant.
- 4. Turn up ends of flashings to form end dams at terminations of head and sill flashings, or where flashings abut other construction.
- 5. Unless otherwise indicated, extend flashings to face of masonry and form a drip edge.
- 6. Where flashing details are not indicated on the Drawings, comply with the recommendations of the BIA "Technical Notes on Brick Construction" or NCMA Technical Bulletin No. TEK 19-4, as appropriate for masonry type.
- 7. Coordinate installation of flashings with installation of weep holes to ensure positive drainage to the exterior of the wall.

- L. Insulation Fill: Install loose granular insulation fill in CMU cavities in as work progresses. Install in maximum 2'-0" lifts, completely filling all cells which are not grouted.

M. Wall ties and Reinforcing:

- 1. Horizontal Reinforcement:
 - a. Install truss or ladder design steel wire reinforcement continuously at 16" o.c. in bed joints. Install at 8" o.c. for first 24" above footings and lintels and below sill openings. Install prefabricated tees and corners. Lap 6" at ends and splices.
 - b. Install truss-type reinforcement at single-wythe walls, and ladder type reinforcement at cavity walls.
- 2. Vertical Reinforcement: Place vertical reinforcing bars at locations indicated on the Drawings; use specified bar positioners at spacing indicated on the Drawings or required by local code. Fill reinforced cells in hollow units with grout mix of type specified above or shown on the Drawings.
- 3. Veneer Ties: Install triangular wire veneer ties at vertical and horizontal spacing required by local code to support no more than 2 s.f. of wall area per tie, but in no case more than 24" o.c. horizontally. Stagger alternate rows. Corrugated ties are not allowed.
- 4. Wall Anchors: Anchor masonry walls to structural frame at 24" o.c. vertically along columns, using dovetail anchors at concrete framing and welded strap anchors at steel framing.

N. Grouting:

- 1. Low-Lift Grouting: Grout hollow unit masonry in low-lift grouting in lifts not to exceed 4'-0". Immediately consolidate grout by puddling or mechanical vibration sufficient to cause grout to completely fill all grout spaces.
- 2. High-Lift Grouting:

- a. Minimum dimension of grout space shall be 2".
 - b. Provide cleaning holes at bottom of all cores containing vertical reinforcement in hollow unit masonry. Clean mortar projections and mortar droppings out of grout space and off reinforcing steel with a jet stream of water or as required to clean space.
 - c. Inspect reinforcing steel in place before grouting and provide continuous inspection during grouting operation.
 - d. Allow hollow unit masonry to cure at least 24 hours before grouting. Place grout to not more than 4'-0" lifts, then wait approximately one hour and place another 4'-0" lift.
 - e. Consolidate grout by mechanical vibration during placement; reconsolidate after excess moisture has been absorbed and before plasticity is lost. Reconsolidation may be done as next lift is placed.
 - f. Complete grouting of any section of wall to top of wall in one day.
- O. Allowable Tolerances:
- 1. Maximum variation from plumb:
 - a. In lines and surfaces of columns, walls and arises:
 - 1) $\frac{1}{4}$ " in 10 feet.
 - 2) $\frac{3}{8}$ " in any story or 20 feet maximum.
 - 3) $\frac{1}{2}$ " in 40 feet.
 - b. For external corners, expansion joints and other conspicuous lines:
 - 1) $\frac{1}{4}$ " in any story or 20 feet maximum.
 - 2) $\frac{1}{2}$ " in 40 feet.
 - 2. Maximum variation from level or grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
 - a. $\frac{1}{4}$ " in any bay of 20 feet.
 - b. $\frac{1}{2}$ " in 40 feet.
 - 3. Maximum variation of linear building line from an established position in plan and related portions of columns, walls and partitions:
 - a. $\frac{1}{2}$ " in any bay of 20 feet maximum.
 - b. $\frac{3}{4}$ " in 40 feet.

3.04 FIELD QUALITY CONTROL

- A. Mortar Tests:
- 1. Method: Test mortar for consistency and compressive strength in accordance with ASTM C109 or ASTM C780, using specimens obtained from random field samples.
 - 2. Test quantities: Prepare one set of three cubes for each mortar type at the start of the Work and one set for every 5000 s.f. of masonry wall area.
- B. Masonry Tests:
- 1. Method: Test masonry in accordance with ASTM E447. Make testing specimens in accordance with "Method B" using same materials and workmen to be used in the Work.
 - 2. Test Quantities: Prepare sets of 3 prisms for each type masonry work and one set for every 5000 s.f. of masonry wall area.
- C. Grout Tests:
- 1. Method: Test grout in accordance with ASTM C1019. Use molds formed with masonry units having the same absorptive characteristics and the same moisture contents as used in the work.
 - 2. Test Quantities: Prepare one set of three prisms for each grout type at the start of the Work and one set for every 5000 s.f. of grouted wall area, or when there is a change in

mix proportions, method of mixing or materials used. In any case, prepare at least one set of three prisms per story of building height.

3.05 ADJUSTING

- A. Cutting and Patching: Do miscellaneous patching, cutting, repairing required. Completely fill voids and carefully point joints in new work to correct unsightliness.
- B. Pointing: Point and fill holes and cracks in exposed joints in new work with additional fresh mortar. If mortar has hardened, chisel out defects, wet, and refill solidly with fresh mortar and retool as specified.

3.06 MASONRY CLEANING

- A. General: Clean exposed unit masonry surfaces whether to be sealed or left unsealed. Remove mortar deposited during construction. Leave exposed-to-view unit masonry face surfaces thoroughly cleaned of mortar, discolorations, and stains.
- B. Adjacent Materials: Protect adjacent materials during cleaning operations. Restore materials or surfaces damaged as result of cleaning operations to like-new condition or replace at no additional cost to the Owner.
- C. Preparation:
 - 1. Do not begin cleaning operations less than 48 hours after erection of wall or partition.
 - 2. Prior to commencement of cleaning operations, and in the presence of the Architect and Owner's representative, apply cleaning solution to an inconspicuous area of wall approximately 25 s.f. in area to assure no adverse affect on masonry units or joints. After Architect and Owner review, use same process and materials throughout.
- D. Application:
 - 1. Apply cleaner from top of wall down, using fiber bristle brushes only. Wire brushes are not allowed.
 - 2. Acid solutions may be used to remove stains, but only with written consent of Architect or Owner and unit masonry manufacturer. When allowed, restrict use of acid solutions to well-hardened mortar not less than 7 days old.
 - 3. Thoroughly wash all masonry surfaces with clean water after application of proprietary cleaners or acid solutions. Comply with local environmental regulations governing disposal of run-off of waste water.

3.07 CLEANING AND PROTECTION

- A. Construction Cleaning: Remove all excess materials, packaging materials, debris, scaffolding, and tools; leave the site and work area in clean condition. Leave protective coverings in place until final cleaning.
- B. Final Cleaning: Refer to Section 017400.
- C. Protection of Existing or Completed Work: Protect all projecting masonry liable to damage after setting by suitable, well-supported planking. Securely box jambs and sills of openings used for passage.
- D. Replacement: Remove and replace in its entirety any masonry work showing damage or disfiguration during progress of the Work. Patching or hiding of defects will not be permitted.

END OF SECTION

SECTION 048150 – GLASS UNIT MASONRY

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes glass unit masonry, complete with joint reinforcement, mortar and related work.

1.02 RELATED SECTIONS

- A. Section 042000: Masonry – general.
- B. Section 042000: Lintels.

1.03 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: Manufacturer's actual glass brick units for each form, pattern and color indicated.

1.04 REFERENCES

- A. ASTM A82: Spec for Cold Drawn Steel Wire.
- B. ASTM A 153: Class B-2, Spec Zinc Coating (hot dip) on iron and steel hardware.
- C. ASTM C144: Spec for Aggregate for Masonry.
- D. ASTM C150: Spec for Portland Cement.
- E. ASTM E163: Fire Test of Window Assemblies (equivalent to UL® 9).
- F. ASTM C207: Spec for Hydrated Lime for Masonry Purposes.
- G. ASTM C270: Spec for Mortar for Unit Masonry.
- H. ASTM D1187, Type II: Spec for Asphalt-Base Emulsions (For Metal Surfaces)
- I. ASTM D1227, Type III: Spec for Emulsified Asphalt (For Porous Surfaces)

1.05 SYSTEM DESCRIPTION

- A. Knowledge of the following basic information is essential for proper installation of Pittsburgh Corning Glass Block Units.
 - 1. Glass block panels shall not be designed to support structural loads.
 - 2. Maximum deflection of structural members supporting glass block panels shall not exceed L/600.
 - 3. Sills of all panels must be painted with a heavy coat of asphalt emulsion and must dry for two hours before first mortar bed is placed.
 - 4. Provision for expansion and movement must be made at jambs and heads of all panels. Mortar must not bridge expansion spaces.

5. Mortar should be mixed and applied in accordance with the recommendations of Pittsburgh Corning Corporation. See Materials.

1.06 SUBMITTALS

- A. Product Data: Submit two (2) copies of manufacturer's literature and two (2) copies of manufacturer's installation instructions.
- B. Samples:
 1. Submit two (2) glass block units of each type specified, showing size, design and pattern of faces.
 2. Submit representative samples of panel reinforcing, panel anchors, expansion strips and sealant.

1.07 STORAGE AND PROTECTION

- A. Store unopened cartons of glass block in a clean, cool, dry area.
- B. Protect opened cartons of glass block against windblown rain or water run-off with tarpaulins or plastic covering.

1.08 PROJECT / SITE CONDITIONS

- A. Do not install glass block units when temperature is 40° F and falling. Maintain the temperature of glass unit masonry above 40° F for the first 48 hours after construction.

1.09 WARRANTY

- A. Manufacturer's limited 5-year warranty on glass block units.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Pittsburgh Corning Corporation.
 1. Products of other manufacturers proposed as equivalent quality must be submitted through the requirements of Division 1 for approval by Architect.
 2. Supporting technical data, samples, published specifications and the like must be submitted for comparison.
 3. Contractor shall warrant that proposed substitutions, if accepted, will provide performance equivalent to the materials specified herein.

2.02 GLASS BLOCK UNITS

- A. Pittsburgh Corning "Decora" pattern; 8" x 8" size. Provide polyvinyl butyral edge coating.

2.03 ACCESSORIES

- A. Panel Reinforcing: Two parallel 9 gauge wires either 1 5/8 inch or 2 inch on center with electrically butt-welded cross-wires spaced at regular intervals, hot dipped galvanized after welding, by Pittsburgh Corning Corporation.

- B. Panel Anchors: 20 gauge perforated steel strips 24 inches long by 1 ¾ inches wide, not dipped galvanized after perforation, by Pittsburgh Corning Corporation.
- C. Expansion Strips: Made of polyethylene foam with a thickness of 3/8 inch, by Pittsburgh Corning Corporation.
- D. Asphalt Emulsion: A water-based asphalt emulsion, by Karnak Chemical Corp.
- E. Sealant: Per Section 07900.
- F. Packing: Polyethylene foam, neoprene, fibrous glass or equal as approved by sealant manufacturer.

2.04 MORTAR MATERIALS

- A. Mortar: Type S in accordance with ASTM C270. Mortar shall be 1 part Portland Cement, ½ part lime, and sand equal to 2 ¼ to 3 times the amount of cementitious material (cement plus lime), all measures by volume.
 - 1. Portland cement: Type 1 in accordance with ASTM C150.
 - 2. Lime: Type S, in accordance with ASTM C207.
 - 3. Sand: A clean, white quartzite or silica type, essentially free of iron compounds, for thin joints, in accordance with ASTM C144, not less than 100% passing a No. 8 sieve.

2.05 LOCATIONS

- A. "Icescapes" pattern: Use at all restrooms.
- B. "Decora" pattern: Use at all locations other than restrooms.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Verify that panel anchors have been provided at head and jambs for the purpose of providing panel support within the opening.
- B. Mix all mortar components to a consistency that is drier than mortar for ordinary masonry. Retempering the mortar after it has taken its initial set shall not be permitted. Do not use antifreeze compounds or accelerators.

3.02 INSTALLATION

- A. Cover sill area with a heavy coat of asphalt emulsion. Allow emulsion to dry at least 2 hours before placing mortar.
- B. Adhere expansion strips to jambs and head. Make certain expansion strip extends to sill.
- C. Set full mortar bed joint, applied to sill.
- D. Set lower course of block. Maintain a uniform joint width of ¼ to 3/8 inch plus or minus 1/8 inch. All mortar joints must be full and not furrowed. Steel tools must not be used to tap blocks into position. Do not realign, tap, or otherwise move block after initial placement.

- E. Install panel reinforcing every 16" o.c. maximum in the horizontal mortar joint, and in joints immediately above and below all openings within panels. Where panel anchors are used at jambs and heads in lieu of channel or chase surrounds, install panel anchors in the same joints (16" o.c. maximum) as the panel reinforcing, EXCEPT THAT, at panel corners, anchors shall be placed in each mortar joint, both at the jamb and head, 24" on each side of the corner. Install panel anchors across head joint spaced 16" o.c. maximum. Run reinforcing continuously from end to end of panels. Lap reinforcing not less than 6 inches whenever it is necessary to use more than one length.
 - Install reinforcing as follows:
 - 1. Place lower half of mortar in bed joint. Do not furrow.
 - 2. Press panel reinforcing into place.
 - 3. Cover panel reinforcing with upper half of mortar bed and trowel smooth. Do not furrow.
- F. Place full mortar bed for joints not requiring panel reinforcing. Do not furrow.
- G. Set succeeding courses of block. Space at head of panel and jambs must remain free of mortar for caulking with sealant.
- H. Strike joints smooth while mortar is still plastic and before final set. Remove surplus mortar from faces of glass blocks and wipe dry. Tool joints smooth and concave, before mortar takes final set. At this time remove and clean out all excess mortar from jamb, head and other expansion joint locations.
- I. After final mortar set (approx. 24 hours), install packing tightly between glass block panel and jamb and head construction. Leave space for sealing.
- J. Apply sealant evenly to the full depth of recesses in accordance with the manufacturer's application manual and instructions.

3.03 CLEANING

- A. Remove surplus mortar from the faces of the glass block at the time joints are struck or tooled.
- B. Do not use harsh cleaners, acids, abrasives or alkaline materials while cleaning glass block. Never use steel wool or wire brush to remove mortar from glass block surfaces.
- C. Final mortar removal is accomplished with a clean, wet sponge or cloth.
- D. After all organic sealants, caulking, etc., have been applied, remove excess caulking materials with commercial solvents such as xylene, toluene, mineral spirits or naphtha and follow with normal wash and rinse.
- E. Final cleaning of glass block panels is accomplished after they are completely installed. Wait until panels are not exposed to direct sunlight. Start at the top of the panel and wash with generous amounts of clean water. Use a clean, dry, soft cloth to remove all water from the glass block surface. Change cloth frequently to eliminate dried mortar particles or aggregate that could scratch the glass surface or reflective finish.

END OF SECTION

SECTION 051200 – STRUCTURAL STEEL

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. This section of the work includes all labor, equipment and materials for the following structural steel as shown on the drawings and/or as specified in the Project Manual.
 - 1. Structural steel framing, support and bracing members.
 - 2. Plates, angles, washers, bolts, shims for connections.
 - 3. Welding for fabrication and connectors.
 - 4. Erection.
 - 5. Grouting of base plates and bearing plates.

1.02 RELATED SECTIONS

- A. Section 033000: Cast-in-Place Concrete
- B. Section 042000: Masonry
- C. Section 061000: Carpentry
- D. Section 099100: Painting

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards:
 - 1. AISC “Code of Standard Practice for Steel Buildings and Bridges.”
 - 2. AISC “Specifications for the Design, Fabrication and Erections of Structural Steel for Buildings” and including the “Commentary on the AISC Specifications”.
 - 3. International Building Code standards.
 - 4. AWS D1.1 “Structural Welding Code”.
- B. Notes on Drawings: Notes on the drawings are a part of this specification.

1.04 SUBMITTALS

- A. Submit shop and fabrication drawings in accordance with Section 013000 and with AISC Specifications.
- B. Clearly indicate profiles, sizes, spacing and locations of structural members, connections, attachments anchorages framed openings, size and type of fasteners, cambers and loads.
- C. Verify all applicable dimensions; coordinate with connected and adjacent work.

- D. Indicate welding connections using standard AWS welding symbols. Clearly indicate net welding lengths.
- E. Mill report plans are not required. Certification is required upon request.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Rolled steel shapes, bars and plates: ASTM A-36 unless otherwise noted on the structural drawings.
- B. High strength bolts: ASTM A-325N.
- C. Unfinished bolts and nuts: ASTM A-307.
- D. Grout for base plates and bearing plates: Non-shrink, non-staining high early strength grout. "Five Star Grout" as manufactured by U.S. Grout Corporation.
- E. Primer paint: Fed. Spec. TT-P-636 or SSPC – Paint 13.
- F. Steel Pipe: ASTM A53/A 53M, type E or S, Grade B.
- G. Welding Electrodes.

PART 3 –EXECUTION

3.01 DELIVERY

- A. Deliver all structural steel and miscellaneous metal items clearly marked or tagged. Replace items damaged in shipment upon request.

3.02 FABRICATION

- A. Structural steel shall be fabricated and assembled in the shop to the greatest extent possible. Parts not completely assembled in the shop shall be secured with bolts. All work shall be equal to the best modern shop practices. Connections shall conform to the requirements of AISC specifications. Shop connections shall be welded or bolted. Connections to columns shall be bolted with high strength bolts or welded.
- B. Connections shall be designed in accordance with the reactions shown on the drawings or the reaction for a uniformly loaded beam as tabulated in the AISC Manual of Steel Construction, whichever is greater. Frames for roof openings shall be fabricated in the shop, and field connections shall be welded.

- C. Substitution of sections or modification of detail or both shall not be made without the approval of the Architect. Such changes, when approved, shall be made with no additional cost to Owner.
- D. Weld all permanent connections, grind exposed welds smooth.
- E. Screws or bolts shall be countersunk and drawn tight. Nick threads to prevent loosening.
- F. Joints and fastenings shall be detailed for ample strengths and stiffness. Conceal wherever possible.
- G. Make all connections as indicated on approved drawings.
- H. After erection, touch-up field connections and abraded places with same material as shop coat.

3.03 WELDED CONSTRUCTION

- A. Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
- B. Assemble and weld built-up sections by methods which will produce true alignment of axis without warp.
- C. Inadequate welds shall be ground out and re-welded.

3.04 HOLES FOR OTHER WORK

- A. Provide holes required for securing other work to structural steel framing and for the passage of other work through steel framing members, as shown on the contract drawings.
- B. Provide staggered holes for bolting wood blocking to steel 9/16" diameter holes 3'-0" o.c. when wood blocking is shown adjacent to structural steel.

3.05 SHOP PAINTING

- A. Surfaces requiring shop painting:
 - 1. Shop paint all structural steel work, except those members or portions of members to be embedded in concrete. Do not paint contact surfaces which are to be welded or high-strength bolted with friction type connections. Do not paint top surfaces of beam flanges where composite construction is indicated or where metal deck must be welded to flange.
 - 2. All surfaces shall be shop painted after fabrication, before leaving fabricator's shop.
- B. Surface preparation:

1. Clean surfaces, to be free of loose mill scale, loose rust, weld slag or flux deposit and other foreign matter; clean and prepare surfaces in accordance with SPCC (Steel Structures Painting Council) standards.
2. Remove oil and grease using solvent.
- C. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions and at a rate to provide a uniform, dry film thickness of 2.0 mils using painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

3.06 FIELD PAINTING

- A. Wire brush shop primed surfaces damaged by welding or other causes and apply one brush coat of same materials as used for shop primer.

3.07 GROUTING BASE & BEARING PLATES

- A. Mix as dry as can be worked properly; apply to cleaned dampened surfaces.
- B. Pack solidly to fill entire space.
- C. Tool edges smooth, flush with adjacent surfaces.

3.08 MISCELLANEOUS ITEMS

- A. Furnish base plates, leveling plates, anchor bolts and washers for all items specified in this section.

3.09 STORAGE OF MATERIALS

- A. All material shall be stored above ground. Material shall be kept free of dirt, grease and other foreign matter and shall be protected from corrosion.
- B. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures as directed.

3.10 ERECTION

- A. Comply with the AISC Specifications and Code of Standard Practice, and with specified requirements. Erection shall be in accordance with the applicable sections of the AISC Specification. As erection progresses the work shall be securely fastened and guyed to take care of all load, wind and erection stresses. Damage to the structure because of poor workmanship, inadequate guying, etc., and personal injury because of same shall be the responsibility of the Contractor. Structural damage shall be repaired and/or replaced as directed at no additional cost to Owner.

- B. Provide temporary planking, working platforms, and railings as required and as necessary to effectively complete the work and to provide protection for workmen.
- C. Anchor Bolts:
 - 1. Furnish anchor bolts to be set under the work of other Sections.
 - 2. Establishment of bearing of leveling plates to the correct elevations and centers shall be part of the work of this Section.
 - 3. Furnish templates, adjustable setting sleeves and other devices as necessary for presetting bolts and other anchors to accurate locations.
- D. Setting Bases and Bearing Plates:
 - 1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates. Set bearing plates for structural members on shims. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove shims, but if protruding, cut off flush with the edge of the base or bearing plate.
 - 2. Mix non-shrink grout in strict accordance with the manufacturer's instructions. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain. Finish exposed surfaces and allow to cure in strict compliance with the manufacturer's instructions, or as otherwise required.
- E. Erection Of Steel:
 - 1. Drift pins may be used only to align the several parts in such a manner as to not distort or damage the metal. The use of a torch will not be permitted for correcting fabrication errors, unless approved in writing. High strength bolts shall be installed in accordance with the AISC Specification for Structural Joints Using ASTM A325 Bolts with Load Indicating feature. Standard bolt connections shall have the threads burred after final bolting to prevent nut from working loose. 1/16 inch shims are to be furnished for beams to column connections to properly plumb the columns. Field welding shall be performed by certified welders qualified by test using procedures covered in the American Welding Society Standard.
 - 2. Level and plumb individual members of the structure within specified AISC tolerances to lines and levels indicated.
 - 3. Comply with AISC specifications for bearing, adequacy of temporary connections, alignments and the removal of paint on surfaces adjacent to field welds.
 - 4. No cutting of holes, slot or other openings in the field, by other trades will be permitted without approval by Architect.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds.
- B. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option.
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION

SECTION 052000 – METAL FABRICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes screening at the vending machines, and associated miscellaneous steel and hardware.

1.02 RELATED SECTIONS

- A. Section 042000: Masonry
- B. Section 051200: Structural Steel

1.03 SUBMITTALS

- A. Submit product data for screening.
- B. Submit shop drawings.

PART 2 – PRODUCTS

2.01 PRODUCTS

- A. Steel channels, angles, bars and plates: ASTM A-36 unless otherwise noted on the structural drawings.
- B. $\frac{3}{4}$ " flattened, 10 gauge hot dipped, galvanized expanded metal with U-edging. McNichols Co. or approved equal.

2.02 FABRICATION

- A. Verify dimensions on site prior to shop fabrication.
- B. Fabricate items with joints neatly fitted and properly secured.
- C. Fit and shop assemble in largest particle sections for delivery to site.
- D. Exposed mechanical fastenings: Flush countersunk screws or bolts unobtrusively located consistent with design or structure, except where specifically noted otherwise.

PART 3 – EXECUTION

3.01 DELIVERY

- A. Deliver all items clearly marked or tagged. Replace items damaged in shipment upon request.

3.02 WELDED CONSTRUCTION

- A. Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

3.03 ERECTION

- A. Obtain Architect's review prior to site cutting or making adjustments which are not part of scheduled work.
- B. Install items square and level, accurately fitted and free from distortion or defects.
- C. Make provision for erection stresses by temporary bracing. Keep work in alignment.
- D. Replace items damaged in course of installation.
- E. Perform field welding in accordance with AWS D1.1.
- F. After installation, touch-up field welds and scratched and damaged prime painted and galvanized surfaces. Use a primer consistent with shop coat. Use a primer recommended for galvanized surfaces.
- G. Supply to appropriate sections, items requiring to be cast into concrete or embedded in masonry, complete with necessary setting templates.

3.04 FIELD PAINTING

- A. Wire brush shop primed surfaces damaged by welding or other causes and apply one brush coat of same materials as used for shop primer.

3.05 INSTALLATION

- A. Fabricated items:
 - 1. Install other steel, clip angles, beam hardware and items shown on drawings not classified as structural steel.
 - 2. Grind all welds smooth in fabrication work to be left exposed in completed work.
 - 3. Install as detailed for rigidity and permanence.

END OF SECTION

SECTION 061000 - CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Wood Framing.
2. Wood supports.
3. Wood blocking.
4. Wood cants.
5. Wood nailers.
6. Wood furring.
7. Wood grounds.
8. Wood sheathing.
9. Plywood backing panels.

1.02 SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses.

B. Research/Evaluation Reports: For the following:

1. Treated wood.
2. Engineered wood products.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.02 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive stained or natural finish, mark grade stamp on end or back of each piece.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Wood Structural Panels:

1. Plywood: DOC PS 1.
2. Oriented Strand Board: DOC PS 2.
3. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design / Construction Guide: Residential & Commercial."

2.03 ROUGH CARPENTRY MATERIALS AND COMPONENTS

- A. Lumber: PS 20; West Coast Douglas Fir, Larch or Hem-Fir, graded in accordance with established Grading rules; maximum moisture content of 19 percent; of following grades and stresses where such usages are required in this project:

MATERIALS: (By Use Category)	Minimum Grade	Minimum Stress*
1. Light Framing (4 x 4 and smaller)		
a. General Framing	Standard or "Stud"	525
b. Plates, Blocking and Nailers	Utility	250
2. Studs (4 x 4 and smaller)		
a. Load Bearing	Standard, No. 3 or "Stud"	725
b. Non-Load Bearing (or bearing roof and ceiling load only)	No. 3 or "Stud"	725
3. Studs (2" to 4" thick, 6" wide)		
a. Load bearing or non-load bearing	No. 3 or "Stud"	725
4. Structural Joists and Planks (2" to 4" thick, 5" and wider)		
a. Joists, Floor & Ceiling	No. 1	1300
b. Rafters	No. 1	1300
c. For all other structural framing material	No. 1	1300
d. 2 x 4 and wider Plates, Blocking, Nailers	No. 3	725
e. Stair Stringers	No. 1	1600
5. Posts, Beams and Timbers		
a. (4 x 4 and larger)	No. 1	1600
6. Boards		
a. Shall be suitable for intended use by reasonable carpentry standards.		

* Stress shall be repetitive extreme fiber stress in bending (F b) in pounds per square inch.

- B. Plywood: Engineered Grades, Douglas Fir: Sheathing: CDX

- C. Plywood: Appearance Grades, Douglas Fir:
Interior, one side exposed: A-D-INT-APA
Exterior, one side exposed: A-C-EXT-APA
- D. Nails, Spikes and Staples: Galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations; size and type to suite application.
- E. Bolts, Nuts, Washers, Lags, Pins and Screws: Medium carbon steel; sized to suite application; galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations.
- F. Fasteners: Toggle bolt type for anchorage to hollow masonry; expansion shield and lag bolt type for anchorage to solid masonry or concrete; bolts or power activated type for anchorage to steel.

2.04 WOOD PRESERVATIVE TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP C2 (lumber) and AWP C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWP C31 with inorganic boron (SBX).
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- C. Mark each treated item with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches above grade.
 - 4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.05 TIMBER AND MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Cants.
 - 3. Nailers.
 - 4. Furring.
 - 5. Grounds.
- B. For items of dimension lumber size, provide No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine, No. 2 grade; SPIB.
 - 2. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.06 ENGINEERED WOOD PRODUCTS

- A. Laminated Veneer Lumber: Composite of wood veneers with grain primarily parallel to member lengths, manufactured with exterior type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.

1. Available Manufacturers:
 - a. Boise Cascade Corporation.
 - b. Georgia-Pacific Corporation.
 - c. Louisiana-Pacific Corporation.
 - d. Pacific Woodtech Corp.
 - e. Trus Joist MacMillan.
 - f. Willamette Industries, Inc.
 - g. Approved substitute.

2.07 SHEATHING

- A. Oriented Strand Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.08 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire retardant treated, in thickness indicated, or, if not indicated, not less than 5/8 inch thick.

2.09 SOFFIT BOARD

- A. CertainTeed Weatherboards Fiber-Cement Soffit:
1. Smooth "Fibertect" finish 16" x 12", 1/4" thickness.
 2. Smooth Ventilated "Fibertect" finish 16" x 12", 1/4" thickness.
- B. Locations:
1. Smooth: Rake soffits at enclosed portions of buildings. (Not at open picnic structures).
 2. Smooth Ventilated: Eave soffits at enclosed portions of buildings. (Not at open picnic structures).
 3. Boards shall run the short direction across width of soffit.

2.10 MISCELLANEOUS MATERIALS

- A. Fasteners:
1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 2. Power Driven Fasteners: CABO NER-272.
 3. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Made from hot-dip, zinc coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
1. Available Manufacturers:
 - a. Alpine Engineered Products, Inc.
 - b. Cleveland Steel Specialty Co.
 - c. Harlen Metal Products, Inc.
 - d. KC Metals Products, Inc.
 - e. Silver Metal Products, Inc.,

- f. Simpson Strong-Tie Company, Inc.
 - g. Southeastern Metals Manufacturing Co., Inc.
 - h. United Steel Products Company, Inc.
 - 2. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
 - 3. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Building Paper: Asphalt saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- D. Sill Sealer Gaskets: Glass fiber resilient insulation, fabricated in strip form, for use as a sill sealer; 1 inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- E. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds and similar supports to comply with requirements for attaching other construction.
- B. Apply field treatment complying with AWWPA M4 to cut surfaces of preservative treated lumber and plywood.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the International Building Code.
- D. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
- E. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- F. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- G. Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural use panels and applications indicated.
 - 1. Comply with "Code Plus" provisions in above referenced guide.
- H. Fastening Methods:
 - 1. Sheathing: Nail to wood framing.
 - 2. Plywood Backing Panels: Nail or screw to supports.
- I. Apply building paper horizontally with 2 inch overlap and 6 inch end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with 4 inch overlap.

END OF SECTION

SECTION 061760 – METAL PLATE CONNECTED WOOD TRUSSES

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the following:
 - 1. Wood roof trusses.
 - 2. Wood girder trusses.
 - 3. Truss accessories.
- B. See Division 6 Section “Carpentry and General Work” for supplementary framing and permanent bracing.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal plate connected wood trusses capable of withstanding design loads indicated without exceeding TPI 1 deflection limits.

1.03 SUBMITTALS

- A. Product Data: For metal plate connectors, metal framing anchors, bolts and fasteners indicated.
- B. Shop Drawings: Show location, pitch, span, camber, configuration and spacing for each type of truss required; species, sizes, and stress grades of lumber; splice details; type, size, material, finish, design values, orientation and location of metal connector plates; and bearing details.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. The engineer must be currently registered in the State of Colorado.
- C. Qualification Data: For the following:
 - 1. Metal plate manufacturer.
 - 2. Fabricator.
- D. Research/Evaluation Reports: For the following:
 - 1. Metal plate connectors.
 - 2. Metal framing anchors.

1.04 QUALITY ASSURANCE

- A. Metal Connector Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality control procedures for manufacture of connector plates published in TPI 1.
 - 1. Manufacturer’s responsibilities include preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality assurance program that involves inspection by SPIB, Timber Products Inspection, TPI, or other independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

- C. Comply with TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction," and TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."
- D. Wood Structural Design Standard: Comply with applicable requirements in AFPA's "National Design Specifications for Wood Construction" and it's "Supplement."
- E. Forest Certification: Provide metal plate connected wood trusses produced from wood obtained from forests certified by an FSC accredited certification body to comply with FSC 1.2, "Principles and Criteria."

PART 2 – PRODUCTS

2.01 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
- B. Grade and Species: Any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specifications for Wood Construction" and it's "Supplement."

2.02 METAL PRODUCTS

- A. Metal Connector Plates: Fabricate connector plates to comply with TPI 1 from hot-dip galvanized steel sheet complying with ASTM A 653/A 653M, G60 coating designation; Designation SS, Grade 33, and not less than 0.036-inch thick.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alpine Engineered Products, Inc.
 - b. CompuTrus, Inc.
 - c. Eagle Metal Products.
 - d. Jager Industries, Inc.
 - e. Mitek Industries, Inc.
 - f. Robbins Manufacturing Company.
 - g. TEE-LOK Corporation.
 - h. Truswal Systems Corporation.
- B. Fasteners: Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 1. Nails, Wire, Brads, and Staples: FS FF-N-105.
 - 2. Power-Driven Fasteners: CABO NER-272.
 - 3. Wood Screws: ASME B18.6.1.
 - 4. Lag Bolts: ASME B18.2.1.
 - 5. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

- C. Metal Framing Anchors: Provide framing anchors made from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G 60 coating designation.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but with the capacity of those specified or higher.
 - a. Alpine Engineered Products, Inc.
 - b. Cleveland Steel Specialty Co.
 - c. Harlen Metal Products, Inc.
 - d. KC Metals Products, Inc.
 - e. Silver Metal Products, Inc.
 - f. Simpson Strong-Tie Company, Inc.
 - g. Southeastern Metals Manufacturing Co., Inc.
 - h. United Steel Products Company, Inc.
 - 3. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.03 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install and brace trusses according to TPI recommendations and as indicated. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- B. Anchor trusses securely at bearing points; use metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.
- C. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses as indicated.
- D. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
- E. Install wood trusses within installation tolerances in TPI 1.
- F. Do not cut or remove truss members.
- G. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.

END OF SECTION

SECTION 072000 - INSULATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Furnish and install all insulation types specified herein, except where their installation is specified in other Sections of the specification.
- B. Insulation types included are: Fire safety insulation.

1.02 QUALITY ASSURANCE

- A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by r-values, they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperature indicated.
- B. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Surface Burning Characteristics: ASTM E 84.
 - 2. Fire Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.03 DELIVERY OF MATERIALS

- A. Furnish materials in manufacturers packaging, complete with installation instructions.

1.04 SUBMITTALS

- A. Product data for each type of product indicated.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Unfaced Fiberglass Batt Insulation:
 - 1. Type: Non-combustible, unfaced fiberglass batts complying with ASTM C665, Type I, friction-fit type.
 - 2. Minimum Density: 0.05 lbs/cf.
 - 3. Minimum Thermal Resistance: As required to achieve the design requirements noted in Part 1 above.
 - 4. Fire Hazard: Flame spread 25 or less, smoke developed 50 or less, as determined by ASTM E84.
- B. Rigid Foam Insulation:
 - 1. Type: Extruded polystyrene boards complying with ASTM C578, Type IV.
 - 2. Compressive Strength: 25 psi minimum.

3. Vapor Transmission: 0.4 perms/inch maximum.
4. Water Absorption: 0.1 percent by volume maximum.
5. Minimum Thermal Resistance: 5.0 per inch at 75° F.
6. Edge Detail: Square edge.

2.02 AUXILIARY MATERIALS

- A. Polyethylene Vapor Retarder: 6-mil polyethylene film, with laboratory tested vapor transmission rating of 0.2 perms, natural color.
- B. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, guaranteed compatible with insulation material, and complying with requirements for fire performance characteristics.
- C. Mechanical Anchors: Type and size recommended by insulation manufacturer for type of application and condition of substrate.
- D. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

PART 3 – EXECUTION

3.01 GENERAL

- A. Installation requirements apply both to insulation types which will be installed under this Section and to insulation types that will be furnished under this Section and installed under other Sections.

3.02 INSPECTION AND PREPARATION

- A. Installer shall examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Installer shall submit a written report listing conditions detrimental to performance of work in the section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.
- B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

3.03 INSTALLATION, GENERAL

- A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
- B. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.
- C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.04 PROTECTION

- A. General: Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

END OF SECTION

SECTION 074110 – PREFORMED METAL ROOFING - SIDING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the following: Factory-formed and field-assembled, metal roof panels and wall panels.

1.02 PERFORMANCE REQUIREMENTS

- A. Wind-Uplift Resistance: Comply with UL 580 for wind-uplift resistance class indicated.
- B. Structural Performance: Capable of withstanding the effects of gravity loads and the following loads and stresses based on testing according to ASTM E 1592:
 - 1. Wind Loads: Confirm with structural engineer of record.
 - 2. Snow Loads: Confirm with structural engineer of record.

1.03 SUBMITTALS

- A. Product Data: For each type of metal panel and accessory indicated.
- B. Shop Drawings: Show layouts of metal panels, including plans, elevations, sections, details, trim and attachments to other work.
 - 1. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories.
- C. Samples: Submit one 2' long by full width sample for each exposed finish. Samples will be reviewed for pattern, texture and color only. Compliance with other requirements is the responsibility of the Contractor.
- D. Design and Specification Approval: Prior to starting roofing, submit a signed statement that the roofing and sheet metal flashing design, details and specifications are proper for this particular project and meet wind load design required by the local authorities.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to the following:
 - a. Structural failures, including rupturing, cracking or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory applied finishes within specified warranty period.

1. Fluoropolymer Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.02 PANEL MATERIALS

- A. Prefinished Metal Wall and Roof Panels:
 1. Prefinished steel: 24 Gauge Hot-Dipped Galvanized Steel ASTM A446-85 Grade C, G-90 Coating ASTM A 653-94 and A 924-94.
- B. Prefinished Metal Ceiling Panels: 26 gauge Hot Dipped.
- C. Finish:
 1. On 24 gauge steel; Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.80 to 0.90 mil over 0.20 to 0.25 mil prime coat to provide a total dry film thickness of 1.0 to 1.15 mil. The reverse side shall be coated with a backer coating of 0.25 mil nominal dry film thickness. Finish shall conform to all tests for adhesion, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
 2. On 26 gauge steel: MS Colorfast 25 or equal, polyester resin modified with a silicon resin.
 3. Color: shall be selected from manufacturers standard colors.
 4. Strippable coating shall be applied to the top side of panels to protect the finish during fabrication, shipping and field handling. Strippable coating shall be removed prior to installation.
 5. Field protection shall be supplied by the contractor at the job site so materials is not exposed to weather and moisture.
- D. Flashing: All exposed adjacent flashing shall be of same material and finish as panel system.

2.03 PANEL SEALANTS

- A. Sealant Tape: Pressure-sensitive, gray polyisobutylene compound sealant tape with release-paper backing; ½ inch wide and 1/8 inch thick.
- B. Joint Sealant: ASTM C920; as recommended in writing by metal roof panel manufacturer.
- C. Butyl Rubber Based, Solvent Release Sealant: ASTM C 1311.

2.04 UNDERLAYMENT MATERIALS

- A. Felts: ASTM D 226, Type II (No. 30), asphalt saturated organic felts.

B. Ice and water shield. Johns-Manville or approved equal.

2.05 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory applied coating.

1. Provide fasteners per the roofing Manufacturers recommendations.

2.06 METAL ROOF PANELS

A. Available Manufacturers:

1. Berridge Manufacturing Company.
2. Metal Sales Manufacturing Corporation.
3. Flatiron Steel.
4. Approved substitute.

B. Berridge 'S' Deck, corrugated profile, 24 gauge, straight section panels.

1. Conform to ASTM 653 / 792 Grade C.
2. Roll-formed, continuous lengths.
3. Substitutes may be considered and will require approval of the Architect per Division 1 requirements.
4. Finish: Kynar 500 or Hylar 5000 factory finish.

2.07 METAL WALL PANELS

A. Berridge 'M' Panel, 24 gauge or Metal Sales 'V'-Line 32 panel, 24 gauge.

1. Roll-formed, continuous lengths.
2. Finish: Kynar 500 or Hylar 5000 factory finish.

2.08 CEILING PANELS

A. Use at underside of open picnic structures.

B. 2 ½" corrugated straight panels, 26 gauge, continuous length.

2.09 ACCESSORIES

A. Roof panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fascia, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Clips: Panel clips designed to withstand negative load requirements.

B. Flashing and Trim: Formed from 0.0276 inch thick (24 gauge) metallic coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include eaves, rakes, corners, bases, framed openings, ridges, fascia and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Ridge Ventilation: Coravent V-400 or approved equal.

2.10 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Where indicated, fabricate metal roof panel joints with factory installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
- D. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Install flashings and other sheet metal to comply with requirements specified in Section 076200: Sheet Metal Flashing and Trim.

3.02 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment and building paper slip sheet on roof sheathing under metal roof panels. Use adhesive for temporary anchorage. Apply over open shelters in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Ice and Water Shield: Apply over enclosed building areas.

3.03 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement. Apply wall panels horizontally as shown on Drawings.
 - 1. Field cutting of metal panels by torch is not permitted.
 - 2. Rigidly fasten eave end of metal panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
 - 3. Provide metal closures at peaks, rake edges, rake walls and each side of ridge caps.
 - 4. Flash and seal metal panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

- B. Fasteners: Steel Roof Panels: Use stainless steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies.
 - 1. Seal metal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07920: Joint Sealants.

3.04 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual". Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.05 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION

SECTION 076200 – SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Flashing and trim.
 - 2. Other sheet metal items indicated or noted on the drawings.

1.02 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show layouts, profiles, shapes, seams, dimensions and details for fastening, joining, supporting and anchoring sheet metal flashing and trim.

1.03 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 SHEET METALS

- A. Zinc Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality, mill phosphatized for field painting.
- B. Prepainted, Metallic Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Aluminum Zinc Alloy Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
 - 2. Exposed Finishes: Apply the following coil coating:
 - a. High-Performance Organic Finish: Two-coat thermocured system containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2604, except as modified for below.
 - 1) Humidity and Salt Spray Resistance: 100 hours.
 - 2) Color: Match metal roof color

2.02 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt saturated organic felt, nonperforated.
- C. Elastomeric Sealant: ASMT C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- D. Epoxy Seam Sealer: Two part, non-corrosive, aluminum seam cementing compound.

2.03 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Aluminum: Fabricate nonmoving seams with flat lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat lock seams. Tin edges to be seamed, form seams, and solder.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- D. Expansion Provisions: Where lapped or bayonet type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastimeric sealnat concealed within joints.
- E. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal, and in thickness not less than that of metal being secured.

2.06 STEEP SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket and Backer Flashing: Fabricate from the following material:
 - 1. Prepainted, Metallic Coated Steel: 24 ga., 0.0276 inch thick.
- B. Valley Flashing: Fabricate from the following material:
 - 1. Prepainted, Metallic Coated Steel: 24 ga., 0.0276 inch thick.
- C. Drip Edges: Fabricate from the following material:
 - 1. Prepainted, Metallic Coated Steel: 24 ga., 0.0276 inch thick.

- D. Eave, Rake, Ridge Flashing: Fabricate from the following material:
1. Prepainted, Metallic Coated Steel: 24 ga., 0.0276 inch thick.

2.07 FABRICATION

- A. General:
1. Form items true to detail with clean, strong, sharply defined profiles as detailed, plane surfaces free from warps and buckles. Form corners and transitions from one piece, with mitered corners and flat, lock-type seams. Hem exposed edges ½", turned back to underside.
 2. Where specific conditions or profiles are not covered by Drawings, fabricate items in accordance with SMACNA "Architectural Sheet Metal Manufa", 4th Edition (1987), as directed and approved by the Architect.
 3. Unless otherwise indicated, fabricate flashings and trim from stainless steel of the following thickness or material gauge, based on use or location in the Work.
 - a. Flashings and Counterflashings: Minimum 24 gauge (0.0239")
 - b. Copings: Minimum 20 gauge (0.0359")
 - c. Gutters and Downspouts: Minimum 20 gauge (0.0359")
 - d. Anchor Clips, Cleats and Straps: Minimum 20 gauge 0.0359")
 - e. Concealed Through-Wall Flashings: Minimum 26 gauge (0.0179")
 - f. Other Flashings and Trim: Minimum 24 gauge (0.0239")
- B. Flashings and Metal Wraps: Fabricate to profiles as indicated on Drawings.
- C. Fascias and Copings: Fabricate to profiles indicated; slope copings to drain to concealed side unless otherwise indicated.
- D. Gutters, Leaders and Downspouts:
1. Fabricate to configurations as shown and noted. Size gutters and downspouts in accordance with rainfall data and drainage factor guidelines and recommendations of SMACNA "Architectural Sheet Metal Manual" and Uniform Plumbing Code.
 2. Downspouts shall be open square or rectangular shapes.
 3. Anchor spacing, expansion joint design and spacing, and gutter-to-downspout joints shall be in accordance with SMACNA standard details.
- E. Through-Wall Flashings: Fabricate through-wall flashings with dimples, ridges, or corrugations for bonding with mortar. Unless otherwise indicated, form through-wall flashings to extend within ½" of outer face of masonry.
- F. Miscellaneous: Fabricate clips, cleats, anchors and straps from same material as item to be anchored. Make clips continuous except at expansion joints, regardless of how shown or noted on drawings.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Torch cutting of sheet metal flashing and trim is not permitted.

- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend taps over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 23 inches of corner or intersection. Where lapped or bayonet type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1 ¼" inches for nails and not less than ¾ inch for wood screws.
 - 1. At Galvanized steel or "pre-painted, Metallic Coated Steel": Use stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
- I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1 ½ inches except where pre-tinned surface would show in finished Work.
 - 1. Do not solder pre-painted, metallic-coated steel sheet.

3.02 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.
 - 1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 24 inch centers.
- C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
 - 1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.03

WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall opening components such as windows, doors and louvers.

END OF SECTION

SECTION 079200 – JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
2. Interior joints in vertical surfaces and horizontal non-traffic surfaces.
3. Interior joints in horizontal traffic surfaces.

Seal all open joints between dissimilar materials as required to close and conceal jointing of the work.

1.02 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Manufacturers color charts.

1.04 QUALITY ASSURANCE

- A. Applicator qualifications: Sealant contractor, recognized as such, and in business for at least five years prior to this installation, employing skilled tradesmen for the work.

1.05 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Three years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Dow Corning Corporation, Midland, MI
 2. GE Silicones (General Electric Co.), Waterford, NY
 3. Pecora Corporation, Harleysville, PA
 4. Sonneborn Building Products, Minneapolis, MN

2.02 5. Tremco, Cleveland, OH
MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class and uses related to exposure and joint substrates.
- B. Stain Test Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Single Component Mildew Resistant Neutral Curing Silicone Sealant:

- 1. Products:
 - a. Pecora Corporation: 898.
 - b. Tremco: Tremsil 600 White.
 - c. Approved substitute.
- 2. Type and Grade: S (single component) and NS (non-sag).
- 3. Class: 25.
- 4. Uses Related to Exposure: NT (non-traffic).
- 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

D. Single Component Neutral Curing Silicone Sealant:

- 1. Products:
 - a. Dow Corning Corporation: 799.
 - b. GE Silicones: UltraGlaze SSG4000.
 - c. GE Silicones: UltraGlaze SSG4000AC.
 - d. Tremco: Proglaze SG.
 - e. Tremco: Spectrem 2.
 - f. Tremco: Tremsil 600.
- 2. Type and Grade: S (single component) and NS (non-sag).
- 3. Class: 25.
- 4. Uses Related to Exposure: NT (non-traffic).
- 5. Uses Related to Joint Substrates: G, A, and , as applicable to joint substrates indicated, O.
- 6. Location: Exposed joints within glazed skylight framing system.

E. Multi-component Non-sag Urethane Sealant:

- 1. Products:
 - a. Sonneborn, Division of ChemRex, Inc.: NP 2.
 - b. Tremco: Vulkem 227.
 - c. Tremco: Vulkem 322 DS.
- 2. Type and Grade: M (multi-component) and NS (non-sag).

3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (non-traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

F. Multi-component Pourable Urethane Sealant:

1. Products:
 - a. Pecora Corporation: Dynatrol II-SG.
 - b. Sonneborn, Division of ChemRex, Inc.: SL 2.
2. Type and Grade: M (Multi-component) and P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

G. Single Component Non-sag Urethane Sealant:

1. Products:
 - a. Sika Corporation, Inc.: Sikaflex – 1a.
 - b. Sonneborn, Division of ChemRex, Inc.: Ultra.
 - c. Sonneborn, Division of ChemRex, Inc.: NP 1.
 - d. Tremco: Vulkem 116.
2. Type and Grade: S (single component) and NS (non-sag).
3. Class: 25.
4. Uses Related to Exposure: NT (non-traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
6. Location: Metal flashings and reglet joints.
7. Product above is classified by manufacturer as suitable for Uses T and NT; product below, for Use NT as well as for Class 50.
8. Products listed below are classified by manufacturers as suitable for Uses T and NT.

2.04 LATEX JOINT SEALANTS

A. Latex Sealant LS-1: Comply with ASTM C 834, Type O P, Grade NF.

B. Products:

1. Pecora Corporation: AC-20+.
2. Tremco: Tremflex 834.
3. Approved substitute.

C. Location: Use for all interior joints in field painted vertical and overhead joints not indicated otherwise.

2.05 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed cell material with a surface skin) O (open cell material) B (Bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated, and

of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.06 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.
- B. Cleaners for Non-porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oil residues or other substances capable of staining or harming joint substrates and adjacent non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abraising, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil free compressed air.
 - 2. Remove laitance and form release agents from concrete.
 - a. Clean non-porous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint sealant manufacturer, based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint sea.

3.02 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Product uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.03 JOINT SEALANT SCHEDULE

- A. Exterior vertical and horizontal non-traffic joints: Joint Sealant – multi-component non-sag urethane sealant.
- B. Metal Flashing: Joint sealant – single component neutral curing silicone sealant.
- C. Exposed joints within glazed skylight framing system: Joint sealant – single component neutral curing silicone sealant.
- D. Interior joints between plumbing fixtures and adjoining walls, floors and counters: Joint sealant – single component mildew resistant neutral curing silicone sealant.

- E. Perimeter joints between interior wall surfaces and frames of interior doors and windows: Joint sealant – Latex sealant.
- F. Interior control, expansion and isolation joints in horizontal traffic surfaces of flooring: Joint sealant – multi-component pourable urethane sealant.
- G. Interior control, expansion and isolation joints in horizontal traffic surfaces of flooring: Joint sealant – multi-component pourable urethane sealant.
- H. Interior joints in wet locations that are not painted: Joint sealant – single component mildew resistant neutral curing silicone sealant.

END OF SECTION

SECTION 081100 – HOLLOW METAL DOORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Work under this section comprises of furnishing hollow metal doors and frames, including transom frames, sidelight and window frames with provision for glazed, paneled or louvered openings, fire labeled and non-labeled, as scheduled.

1.02 RELATED SECTIONS

- A. Section 042000: Masonry
- B. Section 061000: Carpentry
- C. Section 087100: Finish Hardware
- D. Section 099000: Painting

1.03 REFERENCES

- A. Standards:
 - 1. ANSI/SDI-100-98 – Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ASTM-F 476-84 – Standard Test Methods for Security of Swinging Doors Assemblies.
 - 3. HMMA 862-87 – Guide Specifications for Commercial Security Hollow Metal Doors and Frames.
 - 4. SDI-105-91 – Recommended Erection Instructions for Steel Frames.
 - 5. SDI-107-78 – Hardware on Steel Doors (reinforcement application).
 - 6. ANSI-A250.4- – Steel Doors and Frames Physical Endurance.
 - 7. UL10C – Standard for Positive Pressure Fire Tests of Door Assemblies.
- B. Codes:
 - 1. 2012 International Building Code.
 - 2. ANSI-A117.1 – Accessible and Usable Building and Facilities.
 - 3. ADA – Americans with Disabilities Act.

1.04 SUBMITTALS

- A. General Requirements: Submit copies of the hollow metal door and frame shop drawings in accordance with Division 1.
- B. Product Data: Submit shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door and frame types, conditions at openings, details of construction, location and installation requirements of door and frame hardware reinforcements and details of joints and connections. Show anchorage and accessory items.
- C. Shop Drawings: Provide a schedule of doors and frames using same reference numbers for details and door openings as those on the contract documents. Shop Drawings should include the following information:
 - 1. Material thickness and/or gauge.

2. Door core material.
3. Mortises and reinforcements.
4. Anchorage types.
5. Locations of exposed fasteners.
6. Glazed, louvered and paneled openings.
7. Mounting locations of standard hardware.

1.05 QUALITY ASSURANCE

- A. Substitutions: All substitution requests must be submitted within the procedures and time frame as outlined in Division 1: Approval of products is at the discretion of the Architect.
- B. Manufacturer Qualifications: Manufacturer shall be a member in good standing of the Steel Door Institute (SDI)

1.06 DELIVERY, STORAGE AND HANDLING

- A. The supplier shall deliver all materials to the project site; direct factory shipments are not allowed unless agreed upon beforehand. Supplier shall coordinate delivery times and schedules with the contractor.
- B. Deliver doors cardboard wrapped or crated to provide protection during transit and jobsite storage. Provide additional protection to prevent damage to any factory-finished doors. Mark all doors and frames with opening numbers as shown on the contract documents and shop drawings.
- C. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to the Architect. Otherwise, remove and replace damaged goods as directed.
- D. Store doors and frames at the building site in a dry and secure place.
 1. Place units on minimum 4" high wood blocking.
 2. Avoid use of non-vented plastic or canvas shelters that could create a humidity chamber.
 3. If cardboard wrapper on door becomes wet, remove carton immediately.
 4. Provide ¼" spaces between stacked doors to promote air circulation.

1.07 WARRANTY

- A. All doors and frames shall be warranted in writing by the manufacturer against defects in materials and workmanship for a period of one (1) year commencing on the date of final completion and acceptance.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide standard hollow metal doors and frames by one of the following:
 1. Ceco Corporation
 2. Curries Company
 3. Steelcraft

2.02 MATERIALS

- A. All doors and frames shall be manufactured of commercial quality cold rolled steel per ASTM A366 and A568 general requirements or galvanized to A60 or G60 minimum coating weight standard per ASTM A924. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM A569.
- B. Supports and anchors shall be fabricated of not less than 18-gauge sheet steel, galvanized where galvanized frames are used.
- C. Where items are to be built into exterior walls, inserts, bolts and fasteners shall be hot dipped galvanized in compliance with ASTM A153, Class C or D as applicable.
- D. Rust inhibitive enamel or paint primer shall be used, baked on, and suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces on Steel Doors and Frames."

2.03 DOORS

- A. Provide 1 ¾" thick doors of materials and ANSI/SDI-100 grades and models specified below, or as indicated on drawings or schedules:
 - 1. Interior Doors: Level 2, Model 2 – Seamless
 - a. Interior doors shall be minimum 18-gauge steel with both lock and hinge rail edge of door intermittently welded, filled and ground smooth the full height of door.
 - 1) Ceco: Regent-18-SEM
 - 2) Curries: 707N-18
 - 3) Steelcraft: L18F
 - 2. Exterior Doors: Level 3, Model 2 – Seamless
 - a. Exterior doors shall be minimum 16-gauge steel with both lock and hinge rail edge of door intermittently welded, filled and ground smooth the full height of door. Exterior doors shall be insulated with a solid slab of expanded polystyrene or polyurethane frame permanently bonded to the inside of each face skin. The top of all doors shall be closed flush by the addition of a 16-gauge screwed-in top cap to prevent water infiltration.
 - 1) Ceco: Imperial-16-SEM
 - 2) Curries: 707N-16
 - 3) Steelcraft: L16F x Polystyrene
- B. All doors shall be beveled 1/8" in 2" and shall have top and bottom channels of not less than 16'gauge, flush or inverted, welded to the face sheets. Doors shall have a full height 14-gauge hinge rail reinforcement channel, or individual 10 gauge hinge reinforcements.
- C. All doors to conform to ANSI-A250.4-1996 Level "A" criteria and shall be tested to 1,000,000 operating cycles and 23 twist tests. Certification of Level "A" doors is to be submitted with approval drawings by supplier upon request. Do not bid or supply any type or gauge of door not having been tested and passed these criteria.

2.04 FRAMES

- A. Provide hollow metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on the drawings and schedules. Conceal fastenings unless otherwise indicated.
 - 1. Interior Frames: Level 2, 16-gauge
 - 2. Exterior Frames: Level 2, 16-gauge
- B. Approved Manufacturers:
 - 1. Ceco: SF Series
 - 2. Curries: M Series
 - 3. Steelcraft: F Series
- C. Fabricate frames with mitered and faces only welded corners, re-prime at the welded areas. All welds to be flush with neatly mitered or butted material cuts.
- D. All frames shall have minimum 7 gauge hinge reinforcements, 14-gauge lock strike reinforcing, and 12-gauge closer reinforcing.
- E. Provide temporary shipping bars to be removed before setting frames.
- F. Except on weatherstripped frames, drill stops to receive three (3) silencers on strike jams of single frames and two (2) silencers on heads of double frames.
- G. Provide minimum 0.0179" thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.05 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.
 - 1. Clearances shall be no more than 1/8" at jams and heads except between non fire rated pairs of doors which may be no more than 1/4". Not more than 3/4" at the bottom of the doors.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel sheet.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and mouldings from either cold- or hot-rolled steel sheet.
- E. Unless otherwise indicated, provide exposed fasteners with countersunk flat or oval heads for exposed screws and bolts.
- F. Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI-107 and ANSI-A115 Series specifications for door and frame preparation for hardware.

- G. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site. Provide internal reinforcements for all doors to receive door closers and exit devices.
- H. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- I. Provide glazing stops with minimum 0.0359" thick steel or 0.040" thick aluminum.
- J. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
- K. Provide screw-applied, removable glazing beads on inside of glass and other panels in doors.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install steel doors, frames and accessories according to shop drawings, manufacturer's data, and as specified.
- B. Comply with provisions of SDI-105, "Recommended Erection Instructions for Steel Door Frames", unless otherwise indicated. Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing concrete, masonry or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
 - 2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

3.02 ADJUSTING AND CLEANING

- A. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- B. Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 083310 – ROLLING SVC DRS

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes manually operated rolling service.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sf. Ft., acting inward and outward.
- B. Operations Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.

1.03 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: Include plans, elevations, sections, details and attachment to other work.
- C. Samples: For each exposed finish.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cookson Company.
 - 2. Raynor
 - 3. Approved substitute.

2.02 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Interlocking slats in a continuous length for width of door of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door.
 - 1. Overhead Door: Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 (Z275) coating designation.
 - 2. Slat Type:
 - a. Flat Slat, 20 ga.

- b. Flat Slat Perforated, 20 ga. Use at bottom 4 slats on each door.
- B. Endlocks and Windlocks: Malleable iron castings, secured to curtain slats to comply with wind load.
- C. Bottom Bar: Manufacturer's standard to suit type of curtain slats.
- D. Curtain Jamb Guides: Material and finish to match curtain slats, with sufficient depth and strength to retain curtain, operate smoothly and to withstand loading.
- E. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opened head. Contour to fit end brackets. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface mounted hoods, and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
 - 1. Steel Door Hoods: At overhead door, minimum 24 ga. (0.0276-inch) thick, hot-dip galvanized steel sheet with rolled edges that matches slat steel.
- F. Push/Pull Handles: At overhead door, galvanized steel lifting handles on each side of door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches high.
- G. Locking Device Assembly: Lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Both jamb sides operable from inside.
 - 2. Lock cylinder is specified in Division 8 Section "Door Hardware."
- H. Counterbalancing Mechanism: Adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
 - 1. Mounting Brackets: Cast iron or cold-rolled steel plate.
- I. Manual Door Operator: Push-up (lift or pull-up) operation not exceeding 25 lbf.

2.03 FINISHES

- A. Overhead Door: Galvanized Steel Finish: Epoxy primer and finished grey polyester.

2.04 WARRANTY

- A. Doors and components shall be free from defects in material and workmanship for a period of one year from the date of delivery to the original purchaser.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head holding strips, anchors, inserts, hangers, and equipment supports.
- B. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion, and with weathertight fit around entire perimeter.

3.02 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain doors.

END OF SECTION

SECTION 083610 – SECTIONAL OVERHEAD DOORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Electrically operated sectional overhead doors.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Loads: Meet local code.

SUBMITTALS

- A. Product Data: For each type and size of sectional overhead door and accessory.
- B. Shop Drawings: For special components and installations not detailed in manufacturer's product data.

QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Doors with Insulated Steel Panels:
 - a. Raynor SteelForm Standard Series S20 (20 gauge) Galvanized Steel Sectional Overhead Door, 2" thick sections.
 - b. Approved Substitute: Refer to Division 1 for substitutions.

2.02 STEEL DOOR SECTIONS

- A. Thermal Insulation: Insulate inner core of steel sections with door manufacturer's 1 3/8" expanded polystyrene insulation. Enclose insulation completely within 24 gauge galvanized steel back cover with R value of 6.11.
- B. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist and deformation.
- C. Color: Manufacturer's standard white to be field painted. Refer to drawings.

2.03 TRACKS, SUPPORTS AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, including brackets, bracing and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Weld or bolt to supports.
- B. Provide 2" tracks configured for standard lift type.
- C. Provide Raynor Dual Durometer Jamb Seal, Floor Seal, Header Seal and Section Joint Seal for a weathertight installation.

2.04 HARDWARE

- A. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.05 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Fabricated from oil-tempered steel wire, mounted on a cross-header tube or steel shaft. Connect to door with galvanized lift cables.

2.06 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, and accessories required for proper operation.
 - 1. Manufacturer: Raynor, Model RCT, ½ H.P. motor.
- B. Disconnect Device: Hand operated disconnect device for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- C. Provide control equipment, maximum 24-V, ac or dc.
- D. Door Operator Type: Unit consisting of electric motor, trolley or drawbar type, and floor level quick release for manual operation.
- E. Electric Motors: High-starting torque, reversible, continuous-duty, with overload protection, sized to start, accelerate and operate door in either direction from any position.
 - 1. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
- F. Remote Control Station: Momentary contact, three button control station with push button controls labeled "Open," "Close," and "Stop."
- G. Obstruction Detection Device: Automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Install door, track and operating equipment complete with necessary hardware according to Shop Drawings, manufacturer's written instructions and as specified.

3.02 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.
- B. Touch-up Painting: Immediately clean field welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.03 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain sectional overhead doors.

END OF SECTION

SECTION 085200 – ALUMINUM WINDOWS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. All materials, equipment and labor necessary for the installation of aluminum windows, with factory glazing, anchors, brackets and attachments in accordance with drawings and as specified herein.

1.02 RELATED SECTIONS

- A. Section 042000: Masonry
- B. Section 076000: Flashing and Sheet Metal
- C. Section 092600: Gypsum Wallboard

1.03 REFERENCE STANDARDS

- A. Windows shall comply with the requirements of AAMA/NWWDA 101/I.S.2-97 (American Architectural Manufacturer's Association).
- B. Units to meet performance standards for:
 - 1. ASTM E 283-91 – Test method for inspection rate of air leakage through exterior windows, curtain walls, and doors under specified pressure differences across the specimen.
 - 2. ASTM E 330-90 – Test method for structural performance of exterior windows, and doors by uniform static air pressure difference.
 - 3. ASTM E 547-93 – Test method for water penetration of exterior windows, curtain walls, and doors by cyclic static air pressure difference.

1.04 SUBMITTALS

- A. Product data: Submit manufacturer's product specifications, technical support data, installation and maintenance recommendations and standard details for each type of unit required, including finishing methods, hardware and accessories.
- B. Product drawings: For each type of window specified, submit standard assembly and details for lap siding, stucco, SMU, brick veneer and power wall. Include stacking bar details for any mulled windows or configurations.
- C. Color samples: Submit sample of specified color.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's instructions for protection of units from damage.
- B. Deliver in manufacturer's protective packaging.

1.06 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing of extruded aluminum with a minimum 10 years documented experience.

1.07 PRODUCT WARRANTY

- A. Provide manufacturer's standard warranty which agrees to repair or replace units that fail in workmanship for a period of ten years from the original date of purchase.
- B. Warranty includes coverage of materials and labor in full by the manufacturer.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Milgard Windows, Inc.
 - 2. Kawneer
 - 3. Approved equal manufacturer's.
- B. Basis of Specification:
 - 1. Products of Milgard Windows, Inc. are specified herein in order to establish a standard of material and quality. Approved substitute products of other manufacturer's which meet or exceed the requirements specified in this Section and the design standards of the specified Milgard window units will be accepted per Division 1.

2.02 PRODUCT

- A. Extruded Aluminum Thermal Break Windows: Picture windows, 36" x 36". (3) total (Maintenance Building) Color: Bronze.

2.03 MATERIALS

- A. Aluminum: Comply with requirements of AAMA/NWWDA 101/I.S.2-97, 6063-T5 temper for strength, corrosion resistance and application of required finish.
- B. Extrusion frame members are to be 0.060 in thickness for structural wall.

2.04 GLASS AND GLAZING

- A. Provide the manufacturer's "Suncoat Glass" sealed insulating glazing material that complies with ASTM E 774-88 Class A and is at least $\frac{3}{4}$ " overall in thickness.
- B. Factory glazed except where field glazing is required due to large window unit dimensions.
- C. Spacer Bar: Stainless steel.
- D. Glazing Stops: Provide screw-applied or snap on glazing stops (beads), coordinated with glass selection and glazing system indicated.

2.05 ACCESSORIES

- A. Fasteners: Provide aluminum, non-magnetic steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with window members, trim hardware, anchors and other components of window units. Where fasteners screw-anchor into aluminum frame members less than 0.125" thick, reinforce the interior with aluminum to receive screw threads, or provide standard, non-corrosive, pressed-in, splined grommet nuts.
- B. Anchors, Clips and Window Accessories: Fabricate anchors, clips and window accessories of aluminum or non-magnetic stainless steel. Anchors, clips and window accessories fabricated of hot-dip zinc coated steel or iron may be used for concealed work.

2.06 FINISH

- A. Clear Anodized Exterior Finish: Provide AA-C22-A31 Class II Clear finish, minimum 0.4 mils thick, electrolytically deposited color anodized finish.

2.07 FABRICATION

- A. Fabricate frames allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.
- B. Provide a poured-in polyurethane insulator as a thermal break, with minimum gap width of .210 in all frame and sash parts that are exposed to interior and exterior air.
- C. Corners shall be precisely mitered with rigid, mechanically fastened joints. All joints shall be sealed.
- D. Provide drainage holes with moisture pattern to exterior.
- E. Prepare components to receive anchor devices. Provide anchorage items.
- F. Provide integral weather stop flange to perimeter of unit.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's specifications and recommendations for installation of window units, hardware, operations, accessories and other window components.
- B. Windows shall be factory sized to fit in each framed opening. Windows will be ½" smaller than the framed (rough) opening to allow ¼" clearance on all sides (tolerance $\pm 1/16"$) for standard wood siding applications.
- C. Windows shall be fabricated to rough opening size with ½" deductions automatically made, so that no additional calculations will be required.

3.02 CLEANING

- A. Clean interior and exterior glass surfaces promptly after installation. Take care to avoid damage to protective coatings and finishes.
- B. Clean all exterior aluminum surfaces.
- C. Do not use petroleum distillants to clean windows.

END OF SECTION

SECTION 087100 – FINISH HARDWARE

PART I – GENERAL

1.01 SUMMARY

A. SECTION INCLUDES

1. The work in this section includes furnishing all items of finish hardware as hereinafter specified or obviously necessary for all swinging, sliding, folding and other doors. Except items, which are specifically excluded from this section of the specification or of unique hardware, specified in the same sections as the doors and frames on which they are installed.

B. RELATED DOCUMENTS

1. Related documents, drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 specification sections apply to this section.

C. RELATED SECTIONS

1. 062000 – Finish Carpentry
2. 081100 – Hollow Metal Doors and Frames
3. 082100 – Flush Wood Doors
4. 084100 – Aluminum Doors and Frames

1.02 REFERENCES

A. STANDARDS

1. ANSI A156.1 – Butts and Hinges
2. ANSI A156.3 – Exit Devices
3. ANSI A156.4 – Door Controls – Door Closers
4. ANSI A156.6 – Architectural Door Trim
5. ANSI A156.7 – Template Hinge Dimensions
6. ANSI A156.8 – Door Controls – Overhead Holders
7. ANSI A156.13 – Mortise Locks and Latches
8. ANSI A156.16 – Auxiliary Hardware
9. ANSI A156.18 – Material and Finishes
10. NFPA80 – Fire Doors and Windows
11. UL10C – Positive Pressure Fire Tests of Door Assemblies

B. CODES

1. 2012 IBC – International Building Code
2. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
3. ADA – Americans with Disabilities Act

1.03 SUBMITTALS

A. GENERAL REQUIREMENTS

1. Submit copies of finish hardware schedule in accordance with Division 1, General Requirements.

B. SCHEDULES AND PRODUCT DATA

1. Schedules to be in vertical format, listing each door opening, and organized into "hardware sets" indicating complete designations of every item required for each door opening to function as intended. Hardware schedule shall be submitted within two (2) weeks from date the purchase order is received by the finish hardware supplier. Furnish four (4) copies of revised schedules after approval for field and file use. Note any special mounting instructions or requirements with the hardware schedule. Schedules to include the following information:
 - a. Location of each hardware set cross-referenced to indications on drawings, both on floor plans and in door and frame schedule.
 - b. Handing and degree of swing of each door.
 - c. Door and frame sizes and materials.
 - d. Keying information.
 - e. Type, style, function, size, and finish of each hardware item.
 - f. Elevation drawings and operational descriptions for all electronic openings.
 - g. Name and manufacturer of each hardware item.
 - h. Fastenings and other pertinent information.
 - i. Explanation of all abbreviations, symbols and codes contained in schedule
 - j. Mounting locations for hardware when varies from standard.
2. Submit catalog cuts and/or product data sheets for all scheduled finish hardware.
3. Submit separate detailed keying schedule for approval indicating clearly how the owner's final instructions on keying of locks has been fulfilled.

C. SAMPLES

1. Upon request, samples of each type of hardware in finish indicated shall be submitted. Samples are to remain undamaged and in working condition through submittal and review process. Items will be returned to the supplier or incorporated into the work within limitations of keying coordination requirements.

D. TEMPLATES

1. Furnish a complete list and suitable templates, together with finish hardware schedule to contractor, for distribution to necessary trades supplying materials to be prepped for finish hardware.

E. ELECTRONIC HARDWARE SYSTEMS

1. Provide complete wiring diagrams prepared by an authorized factory employee for each opening requiring electronic hardware, except openings where only magnetic hold-open devices are specified. Provide a copy with each hardware schedule submitted after approval.
2. Provide complete operational descriptions of electronic components listed by opening in the hardware submittals. Operational descriptions to detail how each electrical component functions within the opening incorporating all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval.
3. Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval.

4. Prior to installation of electronic hardware, arrange conference between supplier, installers and related trades to review materials, procedures and coordinating related work.
5. The electrical products contained within this specification represent a complete engineered system. If alternate electrical products are submitted, it is the responsibility of the distributor to bear the cost of providing a complete and working system including re-engineering of electrical diagrams and system layout, as well as power supplies, power transfers and all required electrical components. Coordinate with electrical engineer and electrician to ensure that line voltage and low voltage wiring is coordinated to provide a complete and working system.

F. OPERATIONS AND MAINTENANCE MANUALS

1. Upon completion of construction and building turnover, furnish two (2) complete maintenance manuals to the owner. Manuals to include the following items:
 - a. Approved hardware schedule, catalog cuts and keying schedule.
 - b. Hardware installation and adjustment instructions.
 - c. Manufacturer's written warranty information.
 - d. Wiring diagrams, elevation drawings and operational descriptions for all electronic openings.

1.04 QUALITY ASSURANCE

A. SUBSTITUTIONS

1. All substitution requests must be submitted before bidding and within the procedures and time frame as outlined in Division 1, General Requirements. Approval of products is at the discretion of the architect and his hardware consultant.

B. SUPPLIER QUALIFICATIONS

1. A recognized architectural door hardware supplier who has maintained an office and has been furnishing hardware in the project's vicinity for a period of at least two (2) years.
2. Hardware supplier shall have office and warehouse facilities to accommodate this project.
3. Hardware supplier shall have in his employment at least one (1) Architectural Hardware Consultant (AHC) or equivalent employee with at least 10 years experience who is available at reasonable times during business hours for consultation about the project's hardware and requirements to the owner, architect and contractor.
4. Hardware supplier must be an authorized factory distributor of all products specified herein.
5. The following companies are pre-qualified bidders for this project.
 - a. Collins Door & Hardware
394 DeLozier Drive
Ft. Collins, CO 80524
Phone: 970.221.2396
 - b. Colorado Doorways
5151 Bannock Street #17

1.05 FIRE-RATED OPENINGS

1. Provide door hardware for fire-rated openings that comply with NFPA80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed by Underwriter's Laboratories (UL) or Warnock Hersey (WH) for use on types and sizes of doors indicated.
2. Project requires door assemblies and components that are compliant with positive pressure and S-label requirements. Specifications must be cross-referenced and coordinated with door manufacturers to ensure that total opening engineering is compatible with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and IBC 7-2, Fire Tests of Door Assemblies.
 - a. Certification(s) of compliance shall be made available upon request by the Authority Having Jurisdiction.

1.06 DELIVERY, STORAGE AND HANDLING

A. MARKING AND PACKAGING

1. Properly package and mark items according to the approved hardware schedule, complete with necessary screws and accessories, instructions and installation templates for spotting mortising tools. Contractor shall check deliveries against accepted list and provide receipt for them, after which he is responsible for storage and care. Any shortage or damaged good shall be made without cost to the owner.
2. Packaging of door hardware is the responsibility of the supplier. As hardware supplier receives material from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set and door numbers to match the approved hardware schedule. Two or more identical sets may be packed in same container.

B. DELIVERY

1. The supplier shall deliver all hardware to the project site; direct factory shipments are not allowed unless agreed upon beforehand. Hardware supplier shall coordinate delivery times and schedules with the contractor. Inventory door hardware jointly with representatives of hardware supplier and hardware installer/contractor until each is satisfied that count is correct.
2. No keys, other than construction master keys and/or temporary keys are to be packed in boxes with the locks.

C. STORAGE

1. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of work will not be delayed by hardware losses both before and after installation.

1.07 WARRANTY

- A. All items, except as noted below, shall be warranted in writing by the manufacturer against failure due to defective materials and workmanship for a minimum period of one (1) year commencing on the date of final completion and acceptance. In the event of product failure, promptly repair or replace item with no additional cost to the owner.

1. Mortise locksets: Five (5) years
2. Exit Devices: Five (5) years
3. Door closers: Ten (10) years

PART II – PRODUCTS

2.01 MANUFACTURERS

- A. Only manufacturers as listed below shall be accepted. Obtain each type of finish hardware (hinges, latch and locksets, exit devices, door closers, etc.) from a single manufacturer.

2.02 MATERIALS

A. SCREWS AND FASTENERS

1. All required screws shall be supplied as necessary for securing finish hardware in the appropriate manner. Thru-bolts shall be supplied for exit devices and door closers where required by code and the appropriate blocking or reinforcing is not present in the door to preclude their use.

B. HANGING DEVICES

1. HINGES

- a. Hinges shall conform to ANSI A156.1 and be five-knuckle design, ball bearing as specified with NRP (non-removable pin) feature, at all exterior reverse bevel doors. Unless otherwise scheduled, supply one (1) hinge for every 30" of door height. Hinges shall generally be 4 ½" x 4 ½", except at doors exceeding 36" in width where 5" x 4 ½" hinges shall be provided. Heavy weight hinges (.180) shall be supplied at all high traffic doors where specified. Provide hinges with phillips flat-head screws unless specified otherwise.

- 1) Specified Manufacturer: McKinney
- 2) Approved Substitutes: Hager, Stanley

2. PIVOTS

- a. All pivots shall conform to ANSI 156.4 Grade 1 and shall have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot. The bottom pivot shall carry the full weight of the door.

- 1) Specified Manufacturer: Rixson
- 2) Approved Substitutes: NONE

3. FLOOR CLOSERS

- a. Floor closer shall be of offset hung type and available for labeled, lead lined and regular doors. Floor closer shall have independent and adjustable valves for closing speed, latch speed, and backcheck. Floor closers shall have a built in dead stop to prevent the door from swinging beyond the opening degree and all shall be of non-hold open type unless specified otherwise. Include top and intermediate pivots per the manufacturer's recommendations.

- 1) Specified Manufacturer: Rixson
- 2) Approved Substitutes: NONE

C. FLUSH BOLTS AND ACCESSORIES

- 1. All manual and automatic flush bolts to be furnished as specified.

- a. Specified Manufacturer: Rockwood
- b. Approved Substitutes: Trimco

D. CYLINDERS AND KEYING

1. CYLINDERS

- a. Provide cylinders and keys protected from unauthorized manufacture and distribution by manufacturer's United States patents. The key design and tolerances shall permit the cutting of keys with standard code or duplicating machines. The requirement for a single-purpose or keyway-specific cutting or duplicating machine shall not be allowed. The key design and tolerances shall permit the use of keys and cylinders in existing key systems having similar keyways and sections.

- 1) Specified Manufacturer: Best
- 2) Approved Substitutes: NONE

2. KEYING

- a. All locks and cylinders shall be construction master-keyed. All locks and cylinders to be master-keyed or grandmaster-keyed as directed by the owner. The factory shall key all locks and cylinders. Furnish the following key amounts:

- 1) Two (2) change keys per lock
- 2) Three (3) grand master keys (If required)
- 3) Six (6) master keys per master level (If required)
- 4) Three (3) construction/temporary keys

- b. Master keys and all high-security or restricted keyway blanks shall be sealed in tamper-proof packaged boxes when shipped from the factory. The boxes shall be shrink wrapped and imprinted to ensure the integrity of the packaging.

E. LOCKING DEVICES

1. MORTISE LOCKSETS

- a. All locksets shall be ANSI 156.13 Series 1000 Grade 1. All functions shall be manufactured in a single sized case formed from 12 gauge steel minimum. The lockset shall have a field-adjustable, beveled armored front, with a .125" minimum thickness and shall be reversible without opening the lock body. The lockset shall be 2¾" backset with a one-piece ¾" anti-friction stainless steel latchbolt. The deadbolt shall be a full 1" throw made of stainless steel and have 2 hardened steel roller inserts. All strikes shall be non-handed with a curved lip. To insure proper alignment, all trim, shall be thru-bolted and fully interchangeable between rose and escutcheon designs.
 - 1) Specified Manufacturer: Corbin Russwin ML2200 Series
 - 2) Approved Substitutes: Sargent 8200 Series

F. EXIT DEVICES

1. CONVENTIONAL DEVICES

- a. All exit devices shall be certified to meet ANSI/BHMA A156.3 Grade 1 requirements and shall be listed by Underwriters Laboratories and bear the UL label for life safety in full compliance with NFPA 80 and NFPA 101. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze no less than 0.072" thick. Push rails shall be constructed of 0.062" thick material. Painted or anodized aluminum shall not be considered heavy duty and are not acceptable. Hex key dogging shall be standard for all life safety panic hardware. Lever trim shall be available in finishes and designs to match that of the specified locksets.
 - 1) Specified Manufacturer: None Required on this project
 - 2) Approved Substitutes: N/A

G. DOOR CLOSERS

1. SURFACE MOUNTED CLOSERS

- a. All closers shall have non-ferrous covers, aluminum alloy bodies, forged steel arms, and separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be constructed with a one-piece body. Closers shall be furnished with parallel arms mounting on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Furnish with non-hold open arms unless otherwise indicated. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 - 1) Specified Manufacturer: Norton 7500 Series
 - 2) Approved Substitutes: Sargent 351 Series

H. ELECTROMAGNETIC LOCKS

1. MAGNALOCKS

- a. Magnalocks shall operate on 24VDC input. The lock shall not consume more than three (3) watts of power (125mA @ 24VDC). The lock shall be capable of providing a pull-apart or tensile holding force of at least 1200 pounds. The strike plate shall be mounted using a steel sex bolt and roll pin to provide a "floating" movement to assure automatic self-alignment with the lock. Anti-tamper caps shall be provided for the exposed holes. The lock and strike shall be plated to provide corrosion proofing. The lock shall be full sealed

in resin to make it tamper and weather proof. The lock shall contain a suppression circuit to prevent residual magnetism and inductive kickback. The circuit also shall provide accelerated field collapse and radiation suppression. Ten feet of jacketed stranded conductor shall be provided for electrical connection.

- 1) Specified Manufacturers: Securitron Model 68
- 2) Approved Manufacturers: NONE

I. DOOR TRIM AND PROTECTIVE PLATES

1. Kick plates shall be .050 gauges and two (2) inches less full width of door, or as specified. Push plates, pull plates, door pulls and miscellaneous door trim shall be as shown in the hardware schedule.

- a. Specified Manufacturer: Rockwood
- b. Approved Substitutes: Trimco

J. DOOR STOPS AND HOLDERS

1. WALL MOUNTED DOOR STOPS

- a. Where a door is indicated on the plans to strike flush against a wall, wall bumpers shall be provided. Provide convex or concave design as indicated.

- 1) Specified Manufacturers: Rockwood
- 2) Approved Substitutes: Trimco

2. OVERHEAD STOPS/HOLDERS

- a. Where specified, overhead stops as shown in the hardware sets are to be provided. Track, slide, arm and jamb bracket shall be constructed of extruded bronze and shock absorber spring shall be of heavy tempered steel. Overhead stops shall be of non-handed design.

- 1) Specified Manufacturers: Rixson
- 2) Approved Substitutes: NONE

K. GASKETING AND THRESHOLDS

1. Provide continuous weatherseal on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide intumescent seals as required to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
2. Provide threshold units not less than 4" wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames. All threshold units shall comply with the Americans with Disabilities Act (ADA.)

- a. Specified Manufacturers: Pemko
- b. Approved Substitutes: National Guard, Zero

L. SILENCERS

1. Furnish rubber door silencers equal to Trimco 1229A for all new interior hollow metal frames, two (2) per pair and three (3) per single door frame, and Trimco 1229B for all wood frames.

2.03 FINISHES

- A. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

PART III – EXECUTION

3.01 EXAMINATION

- A. Contractor shall ensure that the building is secured and free from weather elements prior to installing interior door hardware. Examine hardware before installation to ensure it is free of defects.

3.02 INSTALLATION

- A. Mount hardware units at heights indicated in the following applicable publications, except as specifically indicated or required to comply with the governing regulations.
 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute (DHI.)
 2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. All hardware shall be applied and installed in accordance with best trade practice by an experienced hardware installer. Care shall be exercised not to mar or damage adjacent work.
- C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- D. Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.03 FIELD QUALITY CONTROL

- A. The hardware supplier shall do a final inspection prior to building completion to ensure that all hardware was correctly installed and is in proper working order.

3.04 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
- B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore to proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- C. Instruct owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes and usage of any electronic devices.

3.05 PROTECTION

- A. Contractor shall protect all hardware, as it is stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

3.06 HARDWARE SCHEDULE

- A. The following schedule is furnished for whatever assistance it may afford the Contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware group, provide door or item with hardware same as required for similar purposes. Quantities listed are for each pair of doors, or for each single door.
- B. Manufacturer's Abbreviations:
 - 1. BE - Best
 - 2. CR – Corbin Russwin
 - 3. MC – McKinney
 - 4. NO - Norton
 - 5. PE – Pemko
 - 6. RO – Rockwood
 - 7. RX – Rixson
 - 8. SE - Securitron

Heading 1

Mixed Use Building #3 - Doors: 01

3	Hinges	T4A3386 5 X 4 1/2	26D	MC
1	Lockset	ML2051-NSA x L/CYL	626	CR
1	Cylinder	1E74-C265	626	BE
1	Overhead Stop	1-516 (concealed)	630	RX
1	Weatherstrip	S44D X LAR		PE
1	Threshold	272 A X LAR FHSL25		PE
1	Door Sweep	18061 CNB X LAR TEK SCREWS		PE

Heading 2

Mixed Use Building #3 - Doors: 02, 03

3	Hinges	T4A3386 4 1/2 X 4 1/2	26D	MC
1	Mag. Lock	M68S		SE
1	Push Plate	73F	32D	RO
1	Pull Plate	111 X 73C	32D	RO
1	Closer	7500BF	AL	NO
1	Wall Stop	402	26D	RO
1	Weatherstrip	S44D X LAR		PE
1	Threshold	272 A X LAR FHSL25		PE
1	Door Sweep	18061 CNB X LAR TEK SCREWS		PE
1	Push Button	PB4N x TM9 (Emergency push button sign required)		SE

(Operation – Doors on 24 hour timer and will lock and unlock as programmed by owner. Emergency push button w/momentary time delay for relocking installed on face of hollow metal frame inside each rest room in case door locks when occupied. Override unlocking from the exterior may be obtained via key pad. One power supply, timer, and key pad supplied per building and is listed in Misc. set. Key Pad to be mounted on face of hollow metal frame on Women's rest room. Locate power supply in plumbing chase rooms.)

Heading 3

Mixed Use Building #3 - Doors: 04

3	Hinges	TA2314 4 1/2 X 4 1/2	26D	MC
1	Lockset	ML2051-NSA x L/CYL	626	CR
1	Cylinder	1E74-C265	626	BE
1	Overhead Stop	1-316 (concealed)	630	RX
1	Wall Stop	402 (at door 03, 04, 09A)	626	RO
1	Weatherstrip	S44D X LAR		PE
1	Threshold	272 A X LAR FHSL25		PE
1	Door Sweep	18061 CNB X LAR TEK SCREWS		PE

Heading 4

3	Hinges	T4A3386 4 1/2 X 4 1/2	26D	MC
1	Lockset	ML2051-NSA x L/CYL	626	CR

1	Cylinder	1E74-C265	626	BE
1	Door Closer	7500BF	AL	NO
1	Wall Stop	402	626	RO
1	Weatherstrip	S44D X LAR		PE
1	Threshold	272 A X LAR FHSL25		PE
1	Door Sweep	18061 CNB X LAR TEK SCREWS		PE

Heading 5

Maintenance Building – Doors: 013, 014, 015

Mixed Use Building #2 – Doors: 07A

3	Hinges	TA2714 4 1/2 X 4 1/2	26D	MC
1	Lockset	ML2051-NSA x L/CYL	626	CR
1	Cylinder	1E74-C265	626	BE
1	Door Closer	7500BF	AL	NO
1	Wall Stop	402	626	RO

Heading 6

Mixed Use Building #2 - Doors: 07B

Mixed Use Building #3 - Doors: 06

1	Cylinder	1E74	626	BE
		(Verify type and quantity of cylinders required)		

Note: Balance of hardware by door supplier.

Misc

3	Power Supply	BPS-24-1 x DT-7		SE
3	Key Pad	DK26SS		SE
	(Locate Power Supply and Key Pad CPU in plumbing chase room)			

END OF SECTION

SECTION 092600 – GYPSUM BOARD ASSEMBLIES

PART 1 – GENERAL

1.01 SUMMARY

- A. Extent of each type of gypsum wallboard system required is indicated on drawings.

1.02 SECTION INCLUDES

- A. Trim and accessories required for gypsum board.
- B. Gypsum wall board.
- C. Acoustical sealant.
- D. Taped and sanded joint treatment.
- E. Finish including primer/sealer and skim coat.

1.03 RELATED SECTIONS

- A. Section 061000: Wood framing and furring.
- B. Section 072100: Acoustical insulation, thermal insulation, and vapor barriers for exterior walls.
- C. Section 081000: Hollow Metal Doors and Frames.
- D. Section 085200: Aluminum Windows.
- E. Section 099000: Painting.

1.04 REFERENCE MATERIALS

- A. Gypsum Association (GA):
 - 1. GA-216-85: Recommended Specifications for the Application and Finishing of Gypsum Board.
 - 2. United States Gypsum Company: Gypsum Construction Handbook - current edition.

1.05 SUBMITTALS

- A. Submit product data for each type of product specified.

1.06 QUALITY ASSURANCE

- A. Perform gypsum wallboard systems work in accordance with recommendations of ASTM C754, ASTM C840, GA-216 Current and Edition of U.S. Gypsum Company Gypsum Construction Handbook, unless otherwise specified in this section.
- B. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Stack gypsum boards flat to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or damage metal corner beads and trim.

1.08 PROJECT CONDITIONS

- A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.
- B. For non-adhesive attachment of gypsum board to framing, maintain not less than 40° F.
- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one manufacturer listed in the following paragraph.
- B. Gypsum Board and Related Products:
 - 1. U.S. Gypsum.
 - 2. Georgia-Pacific.
 - 3. Gold Bond Building Products Div., National Gypsum Company.

2.02 GYPSUM BOARD

- A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.
- B. Gypsum Wallboard: ASTM C36, as follows:
 - 1. Foil-backed at insulated exterior walls.
 - 2. Edges: Tapered.
 - 3. Thickness: 5/8".
 - 4. Locations: Office area in maintenance building; storage rooms in mixed use shelters.
- C. Exterior Soffit Board: ASTM C 36, as follows:
 - 1. Type 'X'
 - 2. Edges: Tapered
 - 3. Thickness: 5/8"
 - 4. Locations: Exterior soffits, ceilings of restrooms, storage rooms at maintenance building.

2.03 TRIM ACCESSORIES

- A. Cornerbead and edge trim for interior installation: Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:
 - 1. Sheet steel coated with zinc by hot-dip or electrolytic processes, or with aluminum.
 - 2. Edge trim shapes indicated below by reference to designations of Fig. 1 in ASTM C 840.
 - a. "L" Bead (USG 200 Series) unless otherwise indicated.

2.04 GYPSUM BOARD JOINT TREATMENT MATERIALS

- A. General: Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.
- B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.
 - 1. Where setting-type joint compounds are indicated for use as taping and topping compounds, use formulation for each which develops greatest bond strength and crack resistance and is compatible with other joint compounds applied over it.
 - 2. For pre-filling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.
 - 3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer for this purpose.
 - 4. All purpose compound formulated for use as both taping and topping compound.

2.05 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.
- B. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.
- C. 1 ½" deep '2' furring channels.
- D. Gypsum Board Screws: ASTM C 1002.
- E. Concealed Acoustical Sealant: ASTM C 919 non-drying, non-hardening, non-skinning sealant.
- F. Exposed Acoustical Sealant: ASTM C 919, non-oxidizing, skinning sealants.
- G. Primer sealer coat with filler. Sheetrock First Coat by USG for use in achieving level finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall

construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.
 - 1. Furnish concrete inserts and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.
- B. Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and other equipment supported by studs, with details indicated and with recommendations of gypsum board manufacturer, ok if non available, with "Gypsum Construction Handbook" furnished by USG. Company.
- C. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work which is to be placed in or behind partition framing. Allow such items to be installed after framing is complete.
- D. Brace partitions to structure above to achieve rigidity.

3.03 WALL FURRING INSTALLATION

- A. Erect wall furring directly attached to concrete block and concrete walls.
- B. Erect furring channels horizontally or vertically as shown. Secure in place on alternate channel flanges at maximum 16 inches on center.
- C. Space furring channels maximum 16 inches on center, not more than 2 inches from floor and ceiling lines and abutting walls.

3.04 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with recommendations of GA 216 and U.S. Gypsum Construction Handbook.
- B. Erect single layer standard gypsum board using longest practical panel lengths, with ends and edges occurring over firm bearing. End Joints shall be staggered, not centered on a wall or above doors and windows.
- C. To minimize ridging of butt joints, bevel the gypsum panel ends approximately 1/8" at a 45 degree angle using a sharp utility knife before applying the panels. Peel back and remove any loose paper from the cut end. Loosely butt panels together.
- D. Use screws when fastening gypsum board to metal furring or framing. Use nails or screws when fastening gypsum board to wood furring or framing.
- E. Treat cut edges and holes in moisture resistant gypsum board with sealant.

- F. Place control joints to be consistent with lines of building spaces and in consistent pattern and as recommended by manufacturer.
- G. Place specified corner beads at external corners. Use longest practical lengths. Place specified edge trim where gypsum board abuts dissimilar materials and elsewhere where shown.

3.05 GYPSUM BOARD FINISHING

- A. Gypsum board finishing work shall be done in accordance with the recommendations of GA 216 and USG Construction Handbook.
- B. Level of finish shall meet standards of Level 4, "Levels of Gypsum Board Finish" per National Gypsum Wallboard Products.

3.06 PROTECTION

- A. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensure gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 096500 – RESILIENT FLOORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Preparation of substrate surfaces.
- B. Resilient base.
- C. Cleaning of all surfaces and areas of work.

1.02 REFERENCE STANDARDS

- A. Conform to following reference standards where applicable.
 - 1. FS SS-W-40 - Wall Base: Rubber and Vinyl Plastic.

1.03 QUALITY ASSURANCE

- A. Materials and installation shall conform to manufacturer's specifications and instructions.
- B. Installer shall be an authorized and approved installer of the manufacturer's products.

1.04 SUBMITTALS

- A. Product samples and data.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Armstrong
 - 2. Roppe
 - 3. Tarkett
 - 4. Approved equal
- B. Where manufacturer's products are specified, it is for the purpose of establishing a standard of quality and construction. Refer to Division 1 for substitutions.

2.02 BASE MATERIALS

- A. Base: Conforming to FS SS-W-40 Type I rubber: top set coved, 4 inch high, 1/8 inch thick including pre-moulded end stops and external corners. Use straight type in spaces where carpet is scheduled.

2.03 COLORS

- A. Colors shall be as selected from manufacturer's standard colors.

PART 3 – EXECUTION

3.01 SITE AND SUBSTRATE CONDITIONS

- A. Store flooring materials in area of application. Allow 3 days for material to reach temperature equal with area.

3.02 INSTALLATION – BASE

- A. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.
- B. Miter internal corners. Use pre-moulded sections for external corners and exposed ends.
- C. Install base on solid backing. Adhere tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other obstructions.
- E. Install straight and level to variation of plus or minus 1/8 inch over 10 feet.
- F. Apply to cabinet toe spaces.

END OF SECTION

SECTION 099100 – PAINTING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation and field painting of exposed exterior and interior items and surfaces.

1.02 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each type of finish coat material indicated.
- C. Paint Samples for color selection.

1.03 QUALITY ASSURANCE

- A. Comply with procedures specified in the latest edition of "Painting Specifications" Prepared by the Painting and Decorating Contractors of America (PDCA).

1.04 PROJECT CONDITIONS

- A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F. Maintain storage containers in a clean condition, free of foreign materials and residue.
- B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 95° F.
- C. Apply solvent thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95° F.
- D. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 %; or at temperatures less than 5° F above the dew point; or to damp or wet surfaces.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Paint Products: Benjamin Moore, Carboline, Diamond Vogel, ICI, Kelly-Moore, Kwal-Howells, Pittsburgh Paint, Sherwin Williams, Sophir-Moris, Tnemec, or Wellborn paint companies.
 - 2. Provide field applied primers or undercoats produced by the same manufacturer as the finish coat or coats.

2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

- B. Material Quality: Provide manufacturer's best quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Select all primary products of a coating system from the products of a single manufacturer.
- C. Colors: Colors for buildings shall be selected from Manufacturer's Standard Colors. Refer to Architect's color schedule on the Drawings.

2.03 PREPARATORY COATS

- A. Concrete Unit Masonry Block Filler: High performance latex block filler of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.
- B. Exterior Primer: Exterior alkyd or latex based primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.
 - 1. Ferrous Metal and Aluminum Substrates: Rust inhibitive metal primer.
 - 2. Zinc Coated Metal Substrates: Galvanized metal primer.
- C. Interior Primer: Interior latex based or alkyd primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.
 - 1. Ferrous Metal Substrates: Quick drying, rust inhibitive metal primer.
 - 2. Zinc Coated Metal Substrates: Galvanized metal primer.
 - 3. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

PART 3 – EXECUTION

3.01 APPLICATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. One request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- C. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and re-prime.

2. Cementitious Materials: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small dry, seasoned knots, and apply a thin coat of white shellac or other recommended know sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
5. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. Material Preparation:

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to product a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

F. Exposed Surfaces: Include areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
2. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
3. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

G. Sand lightly between each succeeding enamel or varnish coat.

- H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color and appearance.
- I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.
- K. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- L. Block Fillers: Apply block filler to concrete masonry block at a rate to ensure complete coverage with pores filled.
- M. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- N. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable.
- O. Transparent (Clear) Finishes: Use multiple coats to produce a glass smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

3.02 CLEANING AND PROTECTING

- A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
- B. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- C. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

3.03 EXTERIOR PAINT SCHEDULE

- A. Wood Trim:
 - 1. Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior semi-gloss acrylic latex enamel.

- B. Harditrim – Hardiplank:
 - 1. Acrylic-Enamel Finish: Two finish coats over factory primer.
 - a. Primer: Manufacturers recommended primer for touch up of factory primer.
 - b. Finish Coats: Exterior semi-gloss 100% acrylic latex enamel.
- C. Ferrous Metal:
 - 1. Alkyd-Enamel Finish: Two finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous metal primer (not required on shop-primed items).
 - b. Finish Coats: Exterior semi-gloss alkyd enamel.
- D. Zinc-Coated Metal:
 - 1. Alkyd-Enamel Finish: Two finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior semi-gloss alkyd enamel.
- E. Concrete Unit Masonry:
 - 1. Masonry Sealer: Finish Coats: PROSOCO, Weather Seal Blok-Guard® and Graffiti Control, two coats per manufacturer's recommendations.

3.04 INTERIOR PAINT SCHEDULE

- A. Concrete Unit Masonry:
 - 1. Acrylic Latex Finish: Two finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Interior semi-gloss acrylic latex enamel.
- B. Gypsum Board:
 - 1. Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior semi-gloss acrylic latex enamel.
- C. Wood and Hardboard:
 - 1. Acrylic Latex Finish: Two finish coats over a primer.
 - a. Primer: Interior wood primer for acrylic-enamel and semi-gloss alkyd-enamel finishes.
 - b. Finish Coats: Interior semi-gloss acrylic latex enamel.
- D. Ferrous Metal:
 - 1. Alkyd-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semi-gloss alkyd enamel.
- E. Zinc-Coated Metal:
 - 1. Alkyd-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior semi-gloss alkyd enamel.

END OF SECTION

SECTION 101550 – TOILET COMPARTMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes water and fire resistant solid color reinforced composite units as follows:
 - 1. Toilet Enclosures: Overhead braced and wall mounted.
 - 2. Urinal Screens: Wall mounted.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed finish.

PART 2 – PRODUCTS

2.01 SOLID COLOR REINFORCED PHONOLIC COMPOSITE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bobrick.
 - 2. Approved Substitute.

2.02 PRODUCT

- A. Bobrick Sierra Series Water and fire-resistant solid color reinforced composite toilet partitions and urinal screens, series 1092, overhead braced.

2.03 PARTITION MATERIALS

- A. Stiles: $\frac{3}{4}$ " thick, solid color, with graffiti-resistant surface thermoset and integrally fused into one homogenous piece. Surface, edge and core to be the same color. All units shall meet ICC and NFPA Class B or UBC Class II, ASTM E 84 Fire-Resistance Standards.
- B. Panels: $\frac{1}{2}$ " thick, solid color, with graffiti-resistant surface thermoset and integrally fused into one homogenous piece. Surface, edge and core to be the same color.
- C. Doors: $\frac{3}{4}$ " thick, solid color, with graffiti-resistant surface thermoset and integrally fused into one homogenous piece. Surface, edge and core to be the same color.
- D. Handrail: Extruded anodized aluminum with satin finish. Enclosed construction with sloping top. Face has raised grip-resistant edge.

2.04 HARDWARE

- A. Institutional hardware: All door hardware, u-channels, and angle brackets shall be heavy duty type 304 stainless steel with satin finish: one-piece, full-height hinges shall be 16 gauge (1.6mm); one-piece door keepers shall be 11 gauge (3.2mm); one-piece, full-height U-

channels and angle brackets shall be 18 gauge (1.2mm). U-channels shall be furnished to secure panels to stiles, and angle brackets furnished to secure panels to stiles, and angle brackets furnished to secure panels and stiles to walls. Doors shall be equipped with a self-closing hinge. Two door stops shall be furnished for each door to prevent it from being kicked in/out beyond stile by vandals. Theft-resistant, stainless steel pin-in-head, Torx screws shall be furnished for door hardware, U-channels, and angle brackets. Through bolts shall be used for securing latch keeper and panel-to-stiles brackets. Threaded inserts shall be factory installed to secure all door hinges, latches and doorstops. Manufacturer's service and parts manual shall be provided to the building owner/manager upon completion of project. Through bolted panel to stile U-channel. Spring loaded, self closing hinge runs full height of panels and doors. Vandal resistant door stops, and reinforced latch with through bolted keeper.

2.05 WARRANTY

- A. One year from date of purchase for hardware and mounting brackets.
- B. Ten (10) year warranty for partition panels, doors and stiles against breakage, warpage, delamination and corrosion.

2.06 COLOR

- A. Architect shall select color from manufacturer's standard colors.

2.07 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24 inch wide in-swinging doors for standard toilet compartments and 36 inch wide out-swinging doors with a minimum 32 inch wide clear opening for compartments indicated to be accessible to people with disabilities. Stiles shall be standard sizes.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

- 1. Maximum Clearances:

- a. Pilasters and Panels: ½ inch.
 - b. Panels and Walls: 1 inch.

3.02 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 102100 – METAL WALL LOUVRES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Furnish and install all extruded aluminum, fixed wall louvers as shown on the Drawings or specified herein, or as required to complete the Work.
- B. Related Sections:
 - 1. Section 061000: Carpentry.
 - 2. Section 061760: Wood Trusses.
 - 3. Section 074100: Preformed Metal Roofing and Siding.

1.02 SUBMITTALS

- A. Product Data: For specified product. Include manufacturer's colors for Architect selection.
- B. Shop Drawings: Submit complete shop drawings, including elevations, installation details, dimensions, interface or attachment to adjacent work, and notation or identification of materials, gages or thicknesses, and finishes for work specified herein.
- C. Samples:
 - 1. Submit minimum 12" x 12" corner mock-up of each type louver, indicating typical corner joint construction, blade configuration and spacing, and bird or insect screen attachment.
 - 2. Submit samples of specified finish colors for approval by the Architect.
- D. Manufacturer's Instructions: Submit copies of manufacturer's printed installation instructions.

1.03 QUALITY ASSURANCE

- A. Certifications: Submit written certification from an AMCA licensed and approved testing laboratory that louvers meet all specified performance criteria. Provide AMCA Certified Ratings Seals for all louvers.
- B. Welding Standards: Comply with applicable provisions of D1.2 "Structural Welding Code – Aluminum."
- C. Coordination: Coordinate louver installation with other Sections whose work relates to or is dependent upon the work of this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver louvers in manufacturer's original, unopened containers or protective packaging, properly identified, and with all labels intact and legible.
- B. Acceptance at site: Do not accept louvers at the site until ready for installation or until adequate, protected storage facilities are available.
- C. Storage and Protection: Store louvers above ground, under cover, in a well-ventilated area, and protected from exposure to the elements and from physical damage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Arrow United Industries.
 - 2. Approved Substitute.

2.02 MATERIALS

- A. Model: Arrow Type EA-520-D or approved equal.
- B. Material: Extruded Aluminum 6063-T6/T52 Alloy, .081" thick nominal.
- C. Face of Louver: Head and blades contained within the jambs. 5" drainable blade with 2" blade spacing.
- D. Certification: AMCA 500L-99 specification standard.
- E. Minimum free area: 55%.
- F. Insect Screen: 18/16 mesh, .011" dia. Aluminum wire.
- G. Aluminum Finish: Factory finished after assembly with two coat fluoropolymer resin (minimum 70% "Kynar 500") coating complying with AAMA 605.2, color selected from manufacturers standard by Architect.
- H. Fasteners: Aluminum or stainless steel, with prefinished heads to match louvers, tamper proof type where exposed in finished work.
- I. Anchors and Inserts: Aluminum or stainless steel of type and size required for type of loading and installation indicated. Use expansion bolt devices for drilled-in place anchors.

2.03 FABRICATION

- A. General:
 - 1. Size louvers to suit opening dimensions and conditions, with tolerances for installation, including application of continuous perimeter sealants.
 - 2. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
 - 3. Include supports, anchorages, and accessories required for complete assembly.
- B. Frames and Sills:
 - 1. Fabricate frames and sills with continuously welding at corners and spot welding of flanges with not less than three welds per side.
 - 2. Provide sill extensions and loose sills with continuously welding at corners and spot welding of flanges with not less than three welds per side.
 - 3. Provide sill extensions and loose sills made of same material as louvers where indicated or required by field conditions for drainage to exterior and to prevent water penetrating to interior.
- C. Louver Blades:

1. Unless otherwise indicated, set blades at 45° angle, with storm baffle at center and return bend at upper edge.
 2. Maintain equal blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Insect Screens: Locate insect screens on interior side of louver. Anchor to frame with machine screws at each corner and spaced not more than 12" o.c. at all sides.
- E. Blank-off Panels: Attach blank-off panels to back of louver frames with stainless steel screws or clips as recommended by louver manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.02 INSTALLATION

- A. Louvers:
1. Install louvers in accordance with manufacturer's printed instructions and approved shop drawings.
 2. Install louvers in longest practical lengths, with concealed mullions where joints are required.
 3. Locate and place louver units plumb, level, and at indicated alignment with adjacent work.
 4. Form closely fitted joints with exposed connections accurately located and secured.
 5. Provide all necessary fasteners, anchors, intermediate braces, and other accessories required for complete installation. Use concealed anchors and fasteners wherever possible.
 6. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
 7. Protect aluminum surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

3.03 CLEANING AND PROTECTION

- A. Aluminum Surfaces: Remove protective coverings from prefinished aluminum and clean in accordance with manufacturer's recommendations. Do not use abrasive cleaners or solvents which are harmful to finishes. Remove all dust, dirt, stains, smears, and finger or hand prints.
- B. Protection: Protect completed louvers from damage due to subsequent construction activities, vandalism, or malicious mischief.

3.04 REPAIR AND REPLACEMENT

- A. Damaged Work:
1. Remove and replace louvers or components which are damaged prior to final completion at no additional cost to the Owner.

2. Repair finishes damaged by cutting, welding, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make required alterations, and refinish entire unit, or provide new units.

END OF SECTION

SECTION 104000 – BUILDING SIGNAGE

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Exterior identification signage.

1.02 RELATED SECTIONS

- A. Section 042000: Masonry

1.03 SUBMITTALS

- A. Product Data for each product specified.
- B. Full size sample of typical sign.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable requirements of ANSI A117.1 and Americans with Disabilities Act Accessibility Guidelines (ADAAG), for signage that provides identification of rooms as listed below.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Gemini Incorporated.
 - 2. Asi Sign Systems, Inc.
 - 3. Best Sign Systems.
 - 4. Approved substitute.

2.02 MATERIALS

- A. Exterior Identification Signage:
 - 1. Basis of Specification: Products below shall establish a standard of style, function, performance, material and quality.
 - 2. Products scheduled below are based upon Best Sign System model numbers. Approved substitutions are allowed per Division 1.
 - 3. Signage:
 - a. Material: fiberglass.
 - b. Size: 6" x 8" x ¼" thick.
 - c. Colors: Architect shall select from standard available colors.
 - d. Model numbers:
 - 1. WP287RB. (Men) (6) total.
 - 2. WP288RB. (Women) (6) total.
- B. Incidental Materials and Accessories:

1. Provide all necessary hardware, adhesives and other incidental materials necessary for installation of exterior signage.
- C. Location: Restroom doors and wall locations adjacent to restrooms. Refer to drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.02 PREPARATION

- A. Substrate Preparation: Clean substrates to which interior or other adhesive-applied signs will be applied; remove all dirt, dust, grease, or other substances detrimental to proper bond of adhesives.

3.03 INSTALLATION

- A. General: Mounting heights of all signage must comply with ANSI A117.12 and ADA Accessibility Guidelines (ADAAG).
- B. Interior Signs: Install interior signs on interior doors or wall surfaces with double-sided foam tape in accordance with approved shop drawings. Refer to Drawings for typical mounting heights.

END OF SECTION

SECTION 105500 – FIRE EXTINGUISHERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Recess mounted fire extinguisher cabinets.
- B. Fire extinguishers.

1.02 SUBMITTALS

- A. Submit manufacturer's product data and catalog cuts.

PART 2 – PRODUCTS

2.01 CABINETS

- A. Style 1: 5/16" flat trim, fully recessed mounted style, 18 gauge pressed steel construction with "Vertical Duo" style door and spring tension friction catches. Finish to be white baked enamel inside, prime coat outside. Door frames shall be one piece tubular construction with a continuous hinge. (1) total. Location: Maintenance Building per drawings.
Style 2: 5/16" flat trim, fully recessed mounted style, pressed steel construction with "solid" style door and spring tension friction catches. Finish to be white enamel inside, prime coat outside. Door frames shall be one piece tubular construction with a continuous hinge. Provide "Larsen'Loc".
- B. Size: As required to fit 5 pound general purpose Fire Extinguishers.

2.02 EXTINGUISHERS

- A. Verify that cabinets are sized to accommodate extinguishers.
- B. Extinguishers shall be UL listed and shall bear UL "listing mark" for type, rating and classification of extinguisher.
- C. Approved manufacturers: JL Industries, Larsen's.
- D. Provide one 5-pound multi-purpose ABC dry chemical type extinguisher per new or existing cabinet at locations indicated on the drawings.
 - 1. Approved manufacturers: JL Industries, Larsen's, or Elkhart.

PART 3 – EXECUTION

- A. Install where indicated on drawings. Mounting height per ADA guidelines.
- B. Fasten in place in accordance with manufacturer's instructions.

END OF SECTION

SECTION 108010 – TOILET ACCESSORIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Public use washroom accessories.
- B. Warm air dryers.
- C. Childcare accessories.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule:
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.

PART 2 – PRODUCTS

2.01 PUBLIC USE WASHROOM ACCESSORIES

- A. Basis of Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following.
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. General Accessory Manufacturing Co. (GAMCO).
 - 6. Approved substitute per Division 1.
- B. Grab Bar:
 - 1. Basis of Design Product: Bobrick; B-6806.99.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1 ½ inches.
 - 5. Configuration and Length: As indicated on Drawings, Straight, 36 inches long and Straight, 42 inches long and Straight, 18 inches vertical.
- C. Sanitary Napkin Disposal Unit:
 - 1. Basis of Design Product: Bobrick 270.
 - 2. Mounting: Surface mounted.
 - 3. Door or Cover: Self closing disposal opening cover.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Mirror Unit:

1. Basis of Design Product: Bobrick, B-165 series. (B-165 6 18 x 36 with polished stainless reflective surface)
2. Frame: Stainless steel channel with mitered corners.
3. Hanger: Provide rigid, tamper and theft resistant installation using galvanized steel wall bracket.
4. Reflective surface: Polished stainless steel.
5. Size: 18" x 36"

2.02 TOILET PAPER DISPENSER

A. Basis of Design Product: The design for toilet paper dispenser is based on product indicated. Subject to compliance with requirements, provide the product by:

1. Rest Room World (1-800-257-8557) Refer to Division 1 for approved substitutes.

B. Toilet Paper Dispenser:

1. Basis of Design Product: Rest Room World R-2304.
2. Mounting: Surface mounted.
3. Material and Finish: Stainless steel.

2.03 WARM AIR DRYERS

A. Basis of Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Bobrick Washroom Equipment, Inc.
2. World Dryer Corporation.
3. Approved substitute per Division 1.

B. Warm Air Dryer:

1. Basis of Design Product: World Dryer; #XRA5 or Bobrick B-750.
2. Mounting: Recessed.
3. Operation: Electronic sensor activated with power cut off switch.
 - a. Operation Time: When hands are present.
4. Cover Material and Finish: Cast iron, with white enamel finish.
5. Electrical Requirements: 115 V, 20 A, 2300 W.

2.03 CHILDCARE ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Infant Care Products, Inc.
2. American Specialties, Inc.
3. Brocar Products, Inc.
4. General Accessory Manufacturing Co. (GAMCO)
5. Koala Corporation
6. Safe-Strap Company, Inc.
7. Approved substitute.

B. Diaper Changing Station:

1. Description: Horizontal unit that opens by folding down from stored position and with child protection strap.

- a. Engineered to support a minimum of 250 lb. static load when opened.
- 2. Mounting; Surface mounted, with unit projecting not more than 4 inches from wall when closed.
- 3. Operation: By pneumatic shock absorbing mechanism.
- 4. Material and Finish: High density polyethylene in manufacturer's standard color.
- 5. Liner Dispenser: Built-in.
- 6. ADA Compliant.

2.04 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and re-supplying. Provide minimum of 4 keys to Owner's representative.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Install accessories to meet requirements of ICC/ANSI A 117.1 – 2003 code requirements. Refer to floor plans for locations.

3.02 SCHEDULE

- A. Grab Bars: Install centerline of grab bars 33" minimum to 36" maximum above floor slab. Refer to floor plans for quantities and lengths.
- B. Toilet Paper Dispensers: Install center of 12" roll at 22" above floor slab. One per toilet stall.
- C. Mirrors: Center 1 (one) mirror over each lavatory. Install bottom of reflective surface 40" maximum above floor slab.
- D. Electric Hand Dryers: Install bottom of dryer 38" to 48" above floor slab at locations shown on Drawings.
- E. Sanitary Napkin Dispensers: Install at locations shown on Drawings. One per toilet stall in all women's restrooms.
- F. Diaper Changing Stations: Install to ensure fold out shelf is 38" to 40" above floor slab at locations shown on Drawings. One per restroom.

END OF SECTION

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Section Includes:

1. Picnic tables
2. Bike racks
3. Soccer goals
4. Lacrosse goals
5. Grills
6. Trash Enclosures

1.2 RELATED SECTIONS AND DOCUMENTS

- A. Section 310000: Earthwork.
- B. Section 321300: Rigid Paving.
- C. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.3 SUBMITTALS

- A. Submit manufacturer's technical data. Provide sample prior to placement. Provide soil compaction tests as required in the general conditions.

1.4 QUALITY ASSURANCE

- A. Coordination: All metal edging to be placed after final grades are established.
- B. Perform work with personnel experienced in the work required under direction of a skilled foreman.

1.5 EXISTING CONDITIONS

- A. Contractor shall approve existing conditions prior to beginning all landscape work. Beginning work indicates acceptance of existing conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Picnic Tables: Pilot Rock XT Series Wheelchair Accessible Extended Portable Rectangular Table with Aluminum Top and Seats. Model: XT/G-6AL/E. Hot-Dip Galvanized Frames. Pilot Rock UT Series Rectangular Table with Aluminum Top and Seats. Model UT/G8. Hot Dip galvanized

frames. All with Model ANG-3 Anchor Kit ground anchors straps. Contact RJ Thomas Mfg 712-225-5115.

- B. Bike Racks: PW Athletic Rainbow Rack (inverted U). Model: 1608-01, powder coated. Color to be: black. Contact Recreation Plus at 303-278-1455.
- C. Soccer Goals: Model SGA300 AlumaGoal Powder Coated White 3" round Club Goal with net, ground anchors and transport wheels. Contact BSN Sports at bsnsports.com.
- D. Lacrosse Goals: Model LG-1X Jaypro High End Official Field Lacrosse Goal.
- E. Grills: Pilot Rock Large Group Grill, Model P-1000 with full 360-degree rotation with embedded base.
- F. Trash Enclosures: Custom fabricated enclosure with 6"x6" pressure treated posts, 2"x6" pressure treated rails and braces, powdercoated corrugated 12-gauge metal panels and 1" diameter stainless steel locking bar and associated hardware. Color to be Powdercoated Copper Foil panels and frames.

3.1 PREPARATION

- A. Excavate for footings. Moisten base, compact to 90% of Standard Proctor Density.

3.2 INSTALLATION

- A. Picnic Tables. Install per manufacturer's specifications. Securely anchor to concrete flatwork.
- B. Bike Racks. Install per manufacturer's specifications.
- C. Soccer Goals. Install per manufacturer's specifications.
- D. Grills. Install per manufacturer's specifications.
- E. Trash Enclosures. Install per details.

3.3 FIELD QUALITY CONTROL

- A. All items must be protected from staining, cracking, chipping, vandalism, and other drainage during progress of the work and left in an unblemished condition upon completion.

END OF SECTION 129300

SECTION 310000 – EARTHWORK

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, and Division One and other related specification sections apply to work of this section.

1.2 SECTION INCLUDES

- A. Clearing, grubbing and site preparation
- B. Removal and disposal of debris
- C. Handling, storage, transportation, and disposal of excavated material
- D. Sheet piling, shoring, bracing and protection work
- E. Pumping and dewatering as required or necessary
- F. Backfilling
- G. Pipe embedment
- H. Construction of fills and embankments
- I. Excavation for buildings & structures
- J. Pavement Subgrade preparation
- K. Trench Stabilization
- L. Final grading
- M. Slope Stabilization
- N. Appurtenant work

1.3 RELATED SECTIONS

- A. Section 31 25 00 – Erosion and Sedimentation Controls
- B. Section 32 12 00 – Flexible Paving
- C. Section 32 13 00 – Rigid Paving
- D. Section 32 92 19 – Seeding
- E. Section 32 92 23 – Sodding

1.4 REFERENCES

- A. Ground Engineering Geotechnical Subsurface Exploration Program, Loveland Sports Park Phase 2 (December 21st, 2017)
- B. Ground Engineering Addendum #1, Alternate Pavement Parameters Loveland Sports Park Phase 2 (February 9th, 2018)
- C. AASHTO – American Association of State Highway and Transportation Officials
- D. ASTM – American Society for Testing and Materials
 - 1. C33 – Concrete Aggregates
 - 2. C136 – Sieve Analysis of Fine and Coarse Aggregates
 - 3. D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-Inch Drop
 - 4. D1241 – Material for Soil Aggregate Subbase, Base and Surface Courses
 - 5. D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 6. D4253 – Test Methods for Maximum Index Density of Soils and Unit Weight of Soils Using a Vibratory Table
 - 7. D4254 – Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
 - 8. D4318 – Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - 9. D6938 – Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)
- E. ACI – American Concrete Institute
 - 1. 229 – Controlled Low-Strength Materials
- F. CABO/ANSI – Council of American Building Officials/American National Standards Institute
 - 1. A117.1 – Accessible and Useable Buildings and Facilities Standards
- G. CDOT – Colorado Department of Transportation
- H. OSHA – Occupational Safety and Health Administration
 - 1. Part 1926 – Safety and Health Regulations for Construction

1.5 SUBMITTALS

- A. Submit under provisions of Division One specifications.
- B. Product Data: Submit on all products or materials supplied herein
- C. Test Reports: Indicate supplier, sieve analysis, optimum moisture content and density in accordance with ASTM D698 if appropriate for crushed rock or gravel, pipe embedment and material for fills and embankment

1.6 REGULATORY REQUIREMENTS

- A. Burning will not be allowed on-site. Comply with all applicable codes, regulations, and laws.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- C. Obtain and comply with all requirements of City of Loveland and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.
- D. For public improvements only, in the event of a conflict between municipal standards and this specification, municipal standards for products and installation will govern.
- E. Excavation work will be performed in compliance with City of Loveland and current OSHA requirements.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Protect adjacent structures and surrounding areas from damage during excavation, filling, and backfilling
- B. Protect work from erosion or other similar types of damage until the project has been accepted. Leave protection in place for subsequent contractors' use.
- C. Do not backfill or construct fills during freezing weather. Backfill or construct fills only when temperature is 35°F and rising
- D. Do not use frozen materials, snow, or ice in any backfill or fill area
- E. Do not backfill or construct fill on frozen surfaces
- F. Protect excavated material from becoming frozen
- G. Do not backfill or construct fills or embankments during periods of heavy rainfall or precipitation when soil moisture conditions will not allow proper compaction to be achieved
- H. Do not remove trees from outside excavation or fill areas unless authorized by the Owner; protect from permanent damage by construction activities
- I. Provide temporary bridges for roadways, walkways, driveways, etc.

1.8 QUALITY ASSURANCE

- A. All imported material to be free of hazardous and organic wastes, "clean" as defined by EPA, and approved for its intended use by the Owner or project Geotechnical Engineer.

PART 2 -PRODUCTS

2.1 MATERIALS

- A. General - Soil materials, whether from sources on or off the site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.
- B. Classification of Excavated Materials:
 - 1. No classification applies. Remove and handle all excavated materials regardless of its type, character, composition, condition, or depth. This includes all material that is not classified as rock excavation as described in Paragraph 2.1.B.2 Rock Excavation is included herein.
 - 2. Rock Excavation: classified as removal of solid material that by actual demonstration, in the Engineer's opinion, cannot be reasonably loosened or ripped by either a single-tooth, hydraulically operated ripper mounted on a crawler tractor in good condition rated at a minimum 300 flywheel horsepower or excavated with a minimum 325 flywheel horsepower hydraulic excavator in good condition equipped with manufacturer's standard boom, two rippers and rock points, or
 - a. Material that for convenience or economy is loosened by drilling, or the use of pneumatic tools, is not considered rock excavation
 - b. Removal of boulders larger than 1/2 cubic yard will be classified as rock excavation, if drilling or breaking them apart with power operated hammer, hydraulic rock breaker, expansive compounds, or similar means is both necessary and actually used for their removal
 - c. Contractor to inform Engineer when rock excavation is required prior to performing Work
 - d. Contractor to provide accurate records of excavated rock to confirm quantity of rock excavated.
 - 3. Excavation of rock that cannot be excavated as outlined above will be considered rock excavation and may require alternative means that may include drilling, blasting, or expansive compounds.
 - 4. Waste Materials:
 - a. Waste materials are considered unacceptable materials for compaction or placement fill. Site fills will not include environmental pollutants, hazardous substances or waste, hazardous products or by-products.
 - b. Transport and properly dispose of any rubble and waste materials found in excavation off the Owner's property
 - c. If hazardous, transite or asbestos containing materials are found in excavation, stop work immediately and notify the Owner within one hour of discovery. Comply with special handling requirements.
- C. Fills and Embankments
 - 1. To the maximum extent practical use excess earth from onsite excavation for fills and embankments.
 - 2. Free from rocks or stones larger than 12 inch in greatest dimension and free from brush, stumps, logs, roots, debris, and organic and other deleterious materials
 - 3. Fill and embankment material must be acceptable to Engineer

4. No rocks or stones larger than 6 inch in upper 18 inches of fill or embankment. Where allowed, distribute rocks and stones through the fill to not interfere with compaction.

D. Imported Fill for Fills and Embankments:

1. The Contractor is responsible for obtaining additional material for fills and embankments as necessary to meet the requirements shown on the Drawings.
2. Imported fill conforming to the following:
 - a. Gradation (percent finer by weight ASTM C136): 3" – 100% passing, No. 4 Sieve – 50-100% passing, and No. 200 Sieve – 35% passing (maximum)
 - b. Liquid Limit: 35 (maximum), Plasticity Index: 15 (maximum), Group Index: 10 (maximum)

E. Structural Fill:

1. Imported structural fill, such as a ½-inch minus, CDOT Class 7 Aggregate Road Base, conforming to the following:
 - a. Gradation: 1" – 100% passing (percent finer by weight ASTM C136), No. 8 Sieve – 20-85% passing, and No. 200 Sieve – 15% (maximum)
 - b. Liquid Limit: 30 (maximum), Plasticity Index: 6 (maximum)

F. Topsoil

1. Topsoil is defined as fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth for areas to be seeded or planted. Coordinate testing requirements with Landscape Architect and Owner.
2. Clean topsoil free of plants and seeds will be spread to 6-inch minimum depth or as specified by Drawings, whichever is greater.

G. Grubbings

1. Grubbings are defined as the first 1 inch of surface vegetation and topsoil consisting of primarily existing grass groundcover free of roots, brush, and other objectionable material and debris.
2. Reuse grubbing and surface topsoil containing plants and seeds in designated revegetation areas only.

H. Pipe Embedment: Graded gravel

1. Comply with City of Loveland requirements for pipe embedment for public utilities.
2. 1-1/2" Washed rock

Sieve Size (Inch)	Percent Passing by Weight
2"	100
1-1/2"	95-100
1"	80-95

3/4"	30-45
1/2"	10-25
3/8"	<1

3. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4"	90-100
1/2"	25-60
3/8"	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

4. Well-Graded Sand

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	10-30
No. 200	2-10

5. Squeegee

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	85-100
No. 8	30-70
No. 16	5-40
No. 30	0-15
No. 50	0-10
No. 100	0-5
No. 200	<1

6. Drain Gravel

- a. Crushed rock, granular material with a maximum size of 1-1/2 inch.
- b. Minimum 50% passing No. 4 sieve, maximum 5% retained on No. 200 sieve

I. Compacted Trench Backfill

1. Job excavated material finely divided, free of debris, organic material, and stones larger than 6 inches in greatest dimension without masses of moist, stiff clay, or topsoil
2. In upper 18 inches, no rock or rock excavated detritus, larger than 6 inches except with specific approval from Geotechnical Engineer.
3. No rock greater than 3 inches in greatest dimension within 3 feet of top of pipe
4. Graded gravel: as specified or shown on Drawings for pipe embedment

J. Coarse Base Rock

1. Granular material, maximum 3 inches, less than 10% passing 1-inch sieve.
2. Free of trash, clay and dust
3. Compaction as specified by Geotechnical Engineer

K. Road Base

1. Refer to Ground Engineering Addendum #1, Alternate Pavement Parameters (February 9th, 2018)
2. Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	Percent Passing by Weight
1"	100
$\frac{3}{4}$ "	90-100
No. 4	35-55
No. 30	10-30
No. 200	2-9

2.2 ACCESSORIES

A. Controlled Low Strength Material (Flow Fill)

1. Comply with City of Loveland requirements and ACI 229 for the use of flowable fill within the right-of-way or for public utility trench backfill.
2. Product will be a lean, sand-cement slurry, "flowable fill" or similar material with a 28-day unconfined compressive strength between 50 and 200 psi.

B. Non-woven geotextile fabric

1. Needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Product must be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Product must meet AASHTO M288-06 Class 3 for elongation > 50%.
 - a. Mirafi 140N or accepted substitution

PART 3 -EXECUTION

3.1 EXAMINATION

- A. Field verify the location of all underground utilities, pipelines and structures prior to excavation

3.2 PERFORMANCE — GENERAL

- A. Contractor to verify quantities of cuts and fills and perform all earthwork required to meet the grades as shown on the Drawings, including but not limited to, additional import or export required to handle compaction, building and pavement subgrade preparation, and pipe bedding.
- B. Perform work in a safe and proper manner with appropriate precautions against hazard
- C. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities
- D. Contain all construction activity on the designated site and within the limits of work. Cost of restoration offsite will be the responsibility of the Contractor
- E. Maintain service to pipelines and utilities indicated on Drawings during construction

3.3 PREPARATION

A. Clearing and Grubbing

- 1. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris.
- 2. Strip subgrade for fills and embankments of surface vegetation, sod, tree stumps and organic topsoil. Strip and stockpile all on-site material meeting the topsoil definition for all areas receiving grading where shown on Drawings
- 3. Remove all waste materials from site and dispose. Stockpile all acceptable grubblings for reuse in revegetation areas.
- 4. Remove and dispose of tree stumps and roots over 3 inches in diameter to a minimum depth of 18 inches below the natural surface or 5 feet below finished surface level, whichever is lower.
- 5. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted
- 6. Backfill all excavated depression include grub holes with approved material

B. Preservation of Trees

- 1. Do not remove trees outside fill or excavated areas, except as authorized by Engineer
- 2. Protect trees and their roots within the drip line that are to remain from permanent damage by construction operation
- 3. Trim standing trees in conflict with construction operations as directed by Owner and Landscape Architect.

C. Topsoil Stripping

- 1. Strip onsite material meeting the topsoil definition to minimum depth of 6 inches from areas to receive grading as shown on Drawings.
- 2. Stockpile topsoil in areas designated by Owner and indicated on Drawings where it will not interfere with construction operations and activities and existing facilities
- 3. At the completion of work in each area, place and grade topsoil to maintain gradient as indicated and required. Roughen surface as required for erosion control.

D. Waste and Debris

1. Stockpile all acceptable grubbing for reuse in native revegetation areas
2. Remove and dispose of all waste materials and debris from clearing, grubbing, stripping and demolition off site

E. Stockpiles

1. Segregate materials suitable for the following:
 - a. Topsoil
 - b. Embankments and fills
 - c. Backfill
 - d. Spoils and waste only
2. No excavation will be deposited or stockpiled at any time so as to endanger stability of banks or structures, health of trees and shrubs to be protected, or portions of the Work, either by direct pressure or indirectly by overloading banks contiguous to the operation
3. Stockpile soil materials away from edge of excavations
4. Do not obstruct or prevent access to roads, driveways, ditches, natural drainage channels, and utility control devices
5. If in result of adjacent structures, easement limitations, or other restrictions sufficient storage is not available within Project limits, Contractor will arrange for off-site areas for stockpiling and for moving material to and from the storage area at no additional cost to the Owner

3.4 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

- A. Excavation and backfill operations will be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work.
- B. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work
- C. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner
- D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage will be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, will be borne by the Contractor at no additional expense to the Owner

3.5 DEWATERING

A. General

1. All dewatering activities in accordance with all federal, state, and local regulations regarding site drainage, dewatering, and erosion and sediment control including permitting requirements

2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a “quick” or “boiling” condition. System will not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation’s stability
3. Provide and maintain adequate dewatering equipment including power supply, if necessary, to remove and dispose of surface and groundwater entering excavations, trenches, and other parts of the Work
4. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow all Work to be installed in a dry condition
5. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods
6. Keep each excavation dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result
7. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12 inches below the bottom of the excavation
8. Design, furnish, install, test, operate, monitor and maintain dewatering system of sufficient scope, size and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades
9. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property
10. Maintain all drainage pipes, keep clean and free of sediment during construction and final cleanup
11. Open pumping with sumps and ditches will be allowed, provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes
12. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head
13. Dewatering to surface waterways requires Colorado Department of Public Health and Environment dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, including water treatment prior to discharge, if necessary

B. Design

1. Contractor will be responsible for the accuracy of the Drawings, design data, and operational records required
2. Contractor will be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system

C. Damages

1. Contractor will be responsible for and will repair without cost to the Owner any damage to work in place, or other contractor’s equipment, utilities, residences, highways, roads,

- railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system
2. Remove sub grade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Owner

D. Maintaining Excavation in Dewatered Condition

1. Dewatering will be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted
2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance
3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner
4. System maintenance will include supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition

E. System Removal

1. Remove dewatering equipment from the site, including related temporary electrical service
2. Wells will be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction

3.6 SHEETING, SHORING AND BRACING

- A. All sheeting, shoring and bracing in accordance with OSHA and IBC requirements
- B. Prevent undermining and damage to all structures, buildings, underground facilities, pavements and slabs
- C. Contractor will responsible for obtaining all required permits or easements for encroachments into the public right-of-way and for coordinating any encroachments onto adjacent properties.
- D. If sheet pile cut off walls are required, submit design calculations, stamped by a Colorado licensed Professional Engineer
- E. Contractor will be solely responsible for proper design, installation, operation, maintenance, and any failure of any system component

1. Engineer review of Contractor's design and data does not relieve the Contractor from full responsibility for errors or from the entire responsibility for complete and adequate design and performance of the sheeting, shoring and bracing system
- F. Provide proper and substantial sheeting, shoring, and bracing, in accordance with OSHA Standards as required, to prevent caving or sliding, to protect workmen and the Work, and to protect existing structures and facilities
- G. Design, furnish, build, maintain and subsequently remove, to extent required a system of temporary supports for cut and cover, open cut, temporary bypass road, or trench excavations, including bracing, dewatering, and all associated items to support the sides and ends of excavations where excavation slopes may endanger in-place or proposed improvements, extend beyond construction right-of-ways or as otherwise specified or indicated in the Drawings
 1. Design and build sheeting, shoring, and bracing to withstand all loads that might be caused by earth movement or pressure
 2. Design and build sheeting, shoring and bracing to be rigid, maintain shape and position under all circumstances.
- H. Design excavation support system and components for the following to allow safe and expeditious construction of permanent structures without movement/settlement of the ground and to prevent damage to or movement of adjacent buildings, structures, other improvements and underground facilities
 1. To support lateral earth pressures
 2. Loads from utilities, traffic, construction, buildings and surcharge loads
- I. Provide sheeting, shoring and bracing equipment and materials onsite prior to start of excavation in each section, making adjustments as required to meet unexpected conditions
- J. Contractor will make his own assessment of existing conditions including adjacent property, the possible effects of his proposed temporary works and construction methods, and will select and design support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.
- K. Employ caution in areas of underground facilities, which will be exposed by hand or other excavation methods acceptable to Owner or Engineer.
- L. Space and arrange sheeting and bracing as required to exclude adjacent material and according to the stability of excavation slopes
- M. Do not pull trench sheeting before backfilling
- N. Do not brace sheeting left in place against the pipe, but support it in a manner that precludes concentrated loads or horizontal thrusts on pipe
- O. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment is completed
- P. Damages

1. Contractor will document and all existing damage to adjacent facilities and submit written documentation to Owner and Engineer prior to performing any excavation. Documentation will include written description of existing damages, measurements, diagrams, maps and associated photographs
2. Repair all damage resulting from excavation and remove and place any existing structure or underground facility damaged during shoring and sheeting and all undermined pavements with Owner-approved equal, concrete or asphalt, at no cost to the Owner.

3.7 TRENCH STABILIZATION

- A. Thoroughly compact and consolidate subgrades for concrete structures, precast structures, and utility trench bottoms so they remain firm, dense and intact during required construction activities
- B. Remove all mud and muck during excavation
- C. Reinforce subgrades with crushed rock or gravel if they become mucky during construction activities
- D. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on Drawings
- E. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon
- F. Scarify trench subgrade to a depth of 6 to 8 inches before compaction

3.8 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot
- B. Remove existing unsuitable/uncompacted fill, old foundations, rubble/debris, soft or otherwise unsuitable material, and replace with suitable material in excavation
- C. Extend excavations to a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction and inspections
- D. Trim to neat lines where details call for concrete to be deposited against earth
- E. Excavate by hand in areas where space and access will not permit use of machines
- F. Provide dewatering and temporary drainage as required to keep excavations dry.
- G. Reshape subgrade and wet as required
- H. Notify Geotechnical Engineer when structure excavation has reached designated depth. Do not proceed with structure construction until excavation is approved by Geotechnical Engineer.

3.9 PAVEMENT OVEREXCAVATION AND SUBGRADE PREPARATION

- A. Excavate subgrade for asphalt pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.10 foot. Excavate subgrade for concrete pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.05 foot.
- B. Overexcavate and scarify existing soil as required under pavement areas, slabs, curbs and walks to meet the moisture and compaction specifications herein to a minimum depth of 12 inches.
- C. Extend subgrade preparation a minimum of one foot beyond back of proposed pavement, slabs, curbs and walks.
- D. Extend subgrade preparation a minimum of two feet beyond back of proposed structure foundation limit.
- E. Proof roll with a pneumatic tire equipment with a minimum axle load of 18 kips per axle a maximum of 24 hours prior to paving to locate any soft spots that exhibit instability and deflection beyond subgrade tolerances listed above. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Geotechnical Engineer, will be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas will be proof rolled again and all failures again corrected at the Contractor's expense.
- F. If the Contractor fails to place the sub base, base course, or initial pavement course within 24 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction will be performed again at the Contractor's expense.

3.10 FILLS AND EMBANKMENTS

- A. Using suitable approved materials, shape, trim, and finish cut slopes to conform with contours and elevations indicated on Drawings
- B. Suitable materials will consist of excavations or borrow areas
 - 1. Borrow
 - a. Borrow areas will be arranged by Contractor at no additional cost to Owner and will be subject to approval by Engineer or Geotechnical Engineer
 - b. Includes all topsoils and fill materials from approved offsite locations
- C. Place in uniform layers not exceeding 8 inches in loose thickness, and properly compacted. Will be placed on subgrades approved by Engineer or Geotechnical Engineer
- D. Will not be placed on frozen surface. Do not place snow, ice or frozen materials in fill
- E. Level and roll subgrade so surface materials will be compact and bond with the first layer of fill or embankment
 - 1. Plow and scarify subgrade to a depth of 8 to 12 inches until uniform and free of large clods.

- F. Place in horizontal layers at maximum uncompacted depth per compaction specifications herein.
- G. Spread and level material deposited in piles and windrows before compacting
- H. Thoroughly compact each layer by rolling or other means acceptable to Geotechnical Engineer to meet the moisture and compaction specifications herein.
- I. Alter compaction methods if material fails to meet specified density
- J. Where a trench passes through a fill or embankment, place and compact fill or embankment to 12 inch above the top of the pipe before excavating the trench
- K. Add water and harrow, disc, blade, or otherwise work each layer to obtain the uniform moisture content and adequate compaction
- L. Refer to geotechnical report for additional requirements for fill and embankment preparation requirements.

3.11 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure as described herein.
- C. Refer to geotechnical report for additional requirements for site development material, subexcavation, compaction and related earthwork operations.
- D. Percentage of Maximum Dry Density Requirements: Moisture treat and compact soil to not less than the following percentages of maximum dry density and to within the specified moisture content range of optimum moisture content according to ASTM D698 as follows:

Surface Improvement	Compaction %	Moisture Content
Structures	98%	-2 to +2
Paved Areas	95%	-2 to +2
Utility Trenches	95%	-2 to +2
Lawns or Unpaved Areas	90%	-2 to +2
Public Right-of-way	Per municipal standards	

- 1. Do not deposit or compact tamped or otherwise mechanically compacted backfill if frozen or if in water.
- 2. Take particular care to compact backfill which will be beneath slabs, pipes, drives, roads, parking areas, curb, gutters, or other surface construction.

3.12 BORROW OR SPOIL AREA

- A. Obtain suitable material required to complete fill and embankments from excavation, on-site areas.
- B. The location, size, shape, depth, drainage, and surfacing of borrow or spoil pits will be acceptable to Owner.
- C. Make all areas regular in shape with graded and surfaced side and bottom slopes when completed
- D. Cut side slopes not steeper than 1:1 and uniform for the entire length of any one side
- E. Final grade disturbed areas of borrow to uniform slope (maximum slope = 4:1, minimum slope = 50:1).
- F. Use material free of debris and deleterious material
- G. Contractor is responsible for compliance with Colorado Discharge Permit System and local erosion control permitting requirements for any and all onsite and offsite, disturbed spoil and borrow areas. Upon completion of spoil and/or borrow operations, clean up spoil and/or borrow areas in a neat and reasonable manner to the satisfaction of the offsite property owner, Owner and Engineer.

3.13 DISPOSAL OF EXCESS EXCAVATED MATERIALS

- A. Use excess excavated materials in fills and embankments as indicated on the Drawings to the extent needed. Coordinate with Owner and Engineer on locations for excess material placement.
- B. The Contractor is responsible for disposing of all excess excavated materials from the site to a location approved by the Owner or Engineer and permitted with the local authorities.
- C. At the Owner's discretion and with the Engineer's approval, suitable excess excavated materials from onsite may be disposed offsite at locations directed by Owner or specified on the Drawings.
- D. Remove debris, junk, broken concrete, broken asphalt, rock, stones, stumps, logs, roots, and other unsuitable material from the site and dispose of it.

3.14 BLASTING

- A. Blasting or other use of explosives is not permitted without City of Loveland approval

3.15 TRENCH EXCAVATION

- A. Establish alignment and grade or elevation from offset stakes provided by the Contractor's surveyor.
- B. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings

- C. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection
- D. Where grades or elevations are not fixed on the Drawings, excavate trenches to provide a minimum depth of backfill cover over the top of pipe as follows. Coordinate depth of cover with utility owners. Increase depth as required by utility owner and at crossings. Minimum depths are:
 - 1. 2.0 feet for drainage piping
 - 2. 2.5 feet for gas piping
 - 3. 2.5 feet for electric, telecom, and fiber optic conduit
 - 4. 2.0 feet for irrigation piping
 - 5. 3.0 feet for sanitary sewer
 - 6. 4.5 feet for water piping
 - 7. Increase depth as required at vertical curves and for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades
- E. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation
- F. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 200 feet
- G. Total length of open trench will be limited to 200 feet unless otherwise approved by the Engineer
- H. Except where tunneling or boring is indicated on the Drawings, specified, required by jurisdictional agency or permitted by Engineer, excavate trenches by open cut from the surface
- I. Limiting trench widths
 - 1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment
 - 2. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than 1 foot above the top of the pipe
 - 3. Stipulated minimum clearances are minimum clear distances, not minimum average distances
 - 4. Maximum trench width from six inches above the top of pipe to trench bottom is the pipe outside diameter plus 24 inches
 - 5. Limiting trench widths and permissible clearances from 6 inches above top of pipe to trench bottom for installed pressure and non-pressure piping

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
3	1' 6"	2' 6"
4	1' 6"	2' 6"
6	1' 6"	2' 6"
8	1' 8"	2' 8"
10	2' 0"	3' 0"
12	2' 0"	3' 0"
16	2' 8"	3' 8"
18	3' 0"	4' 0"

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
24	3' 6"	4' 6"
36	4' 6"	5' 0"

6. If the width of the lower portion of the trench exceeds the maximum permitted, provide special pipe embedment, or concrete encasement as required by loading conditions
7. No excessive trench widths will be allowed to avoid the use of sheeting or shoring and bracing

J. Trench Side Walls

1. Will be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the federal, state, and local ordinances and regulations
2. Sheet and brace where necessary and as specified herein
3. Excavate without undercutting

K. Trench Bottom

1. Will be thoroughly protected and maintained when suitable natural materials are encountered
2. Will be thoroughly compacted and in approved condition prior to placing gravel bedding, if required
3. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support between bell holes or end joints of the installed pipe at the Contractor's option
4. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material approved by Engineer
5. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined
6. PVC pipe will not be laid directly on trench bottom

L. Mechanical excavation

1. Do not use where its operation would damage buildings, culverts, or other existing property, structures, or utilities above or below ground; hand excavate only in such areas
2. Use mechanical equipment of a type, design, and construction and operated to provide the following:
 - a. Rough trench bottom elevation can be controlled
 - b. Uniform trench widths and vertical sidewalls are obtained from 1 foot above the top of the installed pipe to the bottom of the trench
 - c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls
3. Do not undercut trench sidewalls
4. Recompact trench bottom disturbed by bucket teeth prior to placement of embedment material

- M. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the Drawings to provide for installation of granular embedment pipe foundation material
- N. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support (between bell holes or end joints) of the installed pipe, Contractor's option
- O. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material as Engineer may direct
- P. For unstable soils, provide concrete or other bedding as directed by Engineer
- Q. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined
- R. Cuts in existing surface construction
 - 1. No larger than necessary to provide adequate working space
 - 2. Cut a clean groove not less than 1½ inch deep along each side of trench or around perimeter of excavation area
 - 3. Remove pavement and base pavement to provide shoulder not less than 6 feet wide between cut edge and top edge of trench
 - 4. Do not undercut trenches, resulting in bottom trench width greater than top widths
 - 5. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation
 - 6. Remove pavement for connections to existing lines or structures only to the extent required for the installation
 - 7. Replace the pavements between saw cuts to match original surface construction

3.16 PIPE EMBEDMENT

- A. Embed pipes above and below the bottom of pipe as indicated on the Drawings and as specified herein
- B. Granular embedment
 - 1. Spread and surface grade granular embedment to provide continuous and uniform support beneath pipe at all points between pipe joints.
 - a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout length
 - b. Barrel of pipe will have a bearing for its full length
 - 2. Form depressions under each joint to permit the proper jointing. No part of joint will be in contact with trench when pipe is placed in position
 - 3. After grading, aligning, and placing pipe in final position, and shoring home, deposit and compact sufficient embedment under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent operations
 - 4. Place and compact embedment material uniformly and simultaneously on both sides of pipe to prevent displacement

5. Complete embedment promptly after jointing operations and approval to proceed by Engineer
 6. Granular embedment compaction by slicing with shovel or vibrating
 - a. Maximum uncompacted thickness of layers: 6 inch
 7. Compacted embedment will be compacted to 90 percent maximum density per ASTM D1557
 - a. Maximum uncompacted depth thickness of horizontal layers: 8 inch
- C. Arch and concrete encasement
1. Include in locations indicated on Drawings or where over-width trench conditions need correction as approved by Engineer
 2. Install and form as indicated on Drawings or as specified
 3. Concrete will have a 28-day minimum 3,000 psi compressive strength
- D. Do not backfill until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems

3.17 TRENCH BACKFILL

- A. Backfilling will be conducted in a continuous manner to prevent damage to the pipe and its coating and kept as close to the pipe laying operation as possible. Backfilling procedures will be in accordance with additional requirements of local authorities or private right-of-way agreements.
- B. Compacted backfill
1. Provide full depth of trench above embedment at all locations
 2. Beneath pavements, surfacing, driveways, curbs, gutters, walks or other surface construction or structures
 3. In street or highway shoulders
 4. Beneath fills and embankments
- C. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to the bottom of the upper trench
- D. Site excavated materials
1. Place job excavated materials in 8 inches maximum uncompacted thickness, uniform layers.
 2. Increased layer thickness may be permitted for incohesive material if Contractor demonstrates to Engineer's satisfaction that specified compacted density will be achieved
 3. Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe
 4. Thoroughly compact each layer to meet the moisture and compaction specifications herein.
- E. Graded gravel
1. Deposit in uniform layers of 9 inches maximum uncompacted thickness.

2. Compact with suitable vibrating roller or platform vibrator to not less than 70 percent relative density per ASTM D4253/D4254
- F. Uncompacted backfill
1. Compaction of backfill above pipe embedment in locations other than those specified, is required only to prevent future settlement
 2. May be placed by any method acceptable to Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and will not result in displacement of installed pipe
 3. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. Distance may be increased 2 feet for each additional 1 foot of cover
- G. Finish the top portion of backfill with at least 6 inches of topsoil or as specified by landscaping specifications, whichever is greater, corresponding to, or better than, that underlying adjoining turf areas.
- H. Trench backfill within the public right-of-way will conform to municipal street and utility standards.
- I. Trench backfills through unimproved areas should be restored to previous conditions and left 3" above adjacent grades to allow for settlement. Seed all disturbed areas according to erosion control and landscape specifications.
- J. Protection of trench backfill
1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion
 2. Install ditch checks where the ditch grade exceeds 1 percent
 - a. Minimum depth: 2 feet below the original ditch or water course bottom for the full bottom width
 - b. Minimum width: 18 inches into the side slopes
 - c. Minimum thickness: 12 inches

3.18 DRAINAGE MAINTENANCE

- A. Do not backfill trenches across roadways, drives, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid
- B. Backfill so that water does not accumulate in unfilled or partially filled trenches
- C. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade, and contours
- D. Do not obstruct surface drainage any longer than necessary
- E. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic

- F. Provide adequate storm flow conveyance through the site at all times during construction to avoid flooding of any buildings or adjacent property. Provide overland drainage routing when storm sewer inlets are not fully functioning due to erosion and sediment control measures.

3.19 FINAL GRADING

- A. After completion of all other outside work and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours, all areas being graded on site
- B. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work
- C. Grade all surfaces for effective drainage, provide a 2 percent minimum slope except as otherwise shown on the Drawings
- D. Provide a smooth transition between adjacent existing grades and new grades
- E. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances
- F. Slope grades to direct water away from buildings and prevent ponds from forming where not intended
- G. Finish subgrades at lawns and unpaved areas to required elevations within a tolerance of plus or minus one (1) inch
- H. Finish grades will be no more than 0.1 foot above or below those indicated
- I. Finish all ditches, swales and gutters to drain readily
- J. Coordinate final subgrade depth with finish landscape treatment and required topsoil depths
- K. Topsoil
 - 1. Clean topsoil, free of plants and seed will be spread to 6-inch minimum depth, or as specified by landscaping specifications, whichever is greater, for areas of the site as detailed by the landscape Drawings.
 - 2. Reuse grubblings and surface topsoil containing plants and seeds in designated revegetation areas only.

3.20 SLOPE AND CHANNEL STABILIZATION

- A. Cover channel banks, slopes, bottom and thalweg (water flowline at lowest point in channel) with erosion control fabric mat where grade is steeper than 4H to 1V and where indicated on the Drawings
- B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

- C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition
- D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil
- E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches
- F. Maintain integrity of erosion control fabric
- G. Prior to laying fabric, seed disturbed areas under provisions of related seeding and landscaping specification sections or as specified on Drawings.

3.21 SETTLEMENT

- A. Warranty for settlement of all fills, embankments, and backfills is stipulated in the General Conditions from final completion of Contract under which Work is performed
- B. Repair or replace within 30 days after notice by Engineer or Owner

3.22 FIELD QUALITY CONTROL

- A. Provide under provisions of General Conditions and Division One Specifications
- B. Coordinate testing with Owner. Owner will provide all field testing to determine compliance of in-place and backfill materials and compaction in accordance with the specifications, and to verify design bearing capacities.
- C. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency advance notification to schedule tests.
- D. Fills and Embankment Testing
 - 1. Two moisture-density relationship tests, ASTM D698, on each type of fill material
 - 2. One in-place compaction test for each 5,000 square feet every 1.5 feet of vertical lift of material placed
 - 3. Additional in-place compaction tests at the discretion of the Owner
- E. Pipe Embedment and Backfill Testing
 - 1. Two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate for each type of embedment on backfill material proposed, except granular embedment material
 - 2. One in-place compaction test every 200 lineal feet of trench in the compacted embedment zone and at every 1.5 feet of vertical lift of backfill materials, per ASTM D6938
 - 3. One in-place compaction test near top of trench for trench depth of 2 feet or less, per ASTM D6938
 - 4. Additional in-place compaction tests at the discretion of the Owner

F. Pavement and Structural Subgrade Testing

1. At a minimum, two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate and adequate for each type backfill material proposed.
2. Perform tests for each footing, concrete site feature, and drainage structure subgrade. Perform tests at every 100 linear feet of subgrade of foundation walls, retaining walls, and every 150 feet for curbing, pans, drainage features, walks, etc. (or portions thereof). Perform tests every 2,000 square feet required of building slab area, exterior slabs and pavement/flatwork areas (with no less than 3 tests). Test at subgrade and at every vertical lift of backfill materials placed.
3. Additional in-place compaction tests at the discretion of the Owner

G. Inspection and approval

1. A qualified Geotechnical Engineer will inspect the natural soil at bottom of excavations for structures
2. Do not prepare subgrade or place concrete until Geotechnical Engineer's inspection has taken place and any resulting recommendations of the Geotechnical Engineer have been fulfilled or until the inspection has been waived by the Geotechnical Engineer
3. Prior to placement of structural fill, overexcavated foundations subgrades will be observed and tested by a qualified Geotechnical Engineer to ensure suitable bearing materials exist
4. Geotechnical Engineer will provide a letter to Engineer to confirm the presence of suitable subgrade material and properly placed fill materials by Contractor in accordance with Drawings and geotechnical report.

H. Retesting of failed compaction will be performed by Geotechnical Engineer for Owner, but paid for the Contractor

END OF SECTION 310000

SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This work consists of temporary measures needed to control erosion and water pollution. These temporary measures will include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project and during site restoration, and as directed by ENGINEER, and as shown on the drawings.
- B. The Erosion Control Plan presented in the drawings serves as a minimum for the requirements of erosion control during construction. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then Contractor shall provide additional measures as required to obtain the required protection.
- C. Contractor shall include in the bid price for erosion control a minimum of all items shown on the Erosion Control Plan and any additional items that may be needed to control erosion and water pollution.

1.2 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork
- B. Section 32 12 00 – Flexible Paving
- C. Section 32 13 00 – Rigid Paving
- D. Section 33 40 00 – Storm Drainage Utilities

1.3 REFERENCES AND STANDARDS

- A. CDOT – Colorado Department of Transportation
- B. UDFCD – Urban Drainage and Flood Control District
- C. CDPHE – Colorado Department of Public Health and Environment

1.4 SUBMITTALS

- A. Submit under provisions of Division One specifications.
- B. Submit the following information:
 - 1. Erosion Control Plan,
 - 2. Construction schedule for Erosion Control per Article Scheduling,

3. Sequencing Plan per Article Scheduling,
4. All applicable permits for Erosion Control.

C. Product data: Submit on all products or materials supplied herein.

1.5 REGULATORY REQUIREMENTS

- A. Obtain and comply with all requirements of City of Loveland and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.
- B. 401 Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit 401):
 1. Contractor shall apply for and obtain a Construction Dewatering Permit 401 from the Colorado Department of Public Health and Environment.
 2. All costs for this permit shall be the responsibility of Contractor.
 3. This permit requires that specific actions be performed at designated times.
 4. Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.
 5. Contractor shall allow the Colorado Department of Public Health and Environment or other representatives to enter the site to test for compliance with the permit.
 6. Non-compliance with the permit can result in stoppage of all work.
- C. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.6 SCHEDULING

- A. Sequencing Plan:
 1. Contractor shall submit a sequencing plan for approval for erosion control in conformance with Contractor's overall Construction Plan for approval by City of Loveland.
 2. Changes to the Erosion Control Sequencing Plan may be considered by City of Loveland only if presented in writing by the Contractor.
- B. Temporary Erosion Control:
 1. When so indicated in the Contract Documents, or when directed by City of Loveland, Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.
 2. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc.
- C. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.
- D. Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.

- E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with all applicable municipal or local Municipal Separate Storm Sewer System (MS4) requirements.
- B. All materials shall be submitted for approval prior to installation.
- C. Natural or biodegradable materials shall be reasonably clean, free of deleterious materials, and certified weed free. Materials may include, but are not limited to, hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel.
- D. Grass Seed:
 - 1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.
 - 2. All grass seed shall be approved by Landscape Architect and City of Loveland and in accordance with local regulations prior to installation.
- E. Fertilizer and soil conditioners shall be approved by Landscape Architect and City of Loveland and in accordance with local regulations prior to installation.
- F. Silt Fence Fabric: woven polypropylene
 - 1. Mirafi 100X, "Envirofence"
 - 2. Or accepted substitution
- G. Temporary Slope Stabilization Mat (short term): 1.5 pound photodegradable polypropylene top and bottom nets, 100% straw fiber matrix, with a longevity of 12 months.
 - 1. North American Green S150
 - 2. Or accepted substitution
- H. Temporary Slope Stabilization Mat (extended term): 3.0 pound UV-stable polypropylene top net, 1.5 pound photodegradable polypropylene bottom net, 70% straw/30% coconut fiber matrix with a longevity of 24 months.
 - 1. North American Green SC150
 - 2. Or accepted substitution
- I. Biodegradable Slope Stabilization Mat (short term): 9.3 pound leno-woven biodegradable jute top net, 7.7 pound woven biodegradable jute bottom net, 100% straw fiber matrix with a longevity of 12 months.
 - 1. North American Green S150BN

2. Or accepted substitution
- J. Biodegradable Slope Stabilization Mat (extended term): 9.3 pound leno-woven biodegradable jute top net, 7.7 pound woven biodegradable jute bottom net, 70% straw/30% coconut fiber matrix with a longevity of 18 months.
1. North American Green SC150BN
 2. Or accepted substitution
- K. Permanent Channel Stabilization Mat [flow velocities between 9.5 (unvegetated) and 15 (vegetated) fps]: 5.0 pound UV-stable polypropylene top and bottom nets, 24 pound UV-stable polypropylene corrugated center net, 70% straw/30% coconut fiber matrix.
1. North American Green SC250
 2. Or accepted substitution
- L. Permanent Channel Stabilization Mat [flow velocities between 10.5 (unvegetated) and 20 (vegetated) fps]: 8.0 pound UV-stable polypropylene top and bottom nets, 24 pound UV-stable polypropylene corrugated center net, 100% coconut fiber matrix.
1. North American Green SC350
 2. Or accepted substitution
- M. Permanent Channel Stabilization Mat [flow velocities between 12.5 (unvegetated) and 25 (vegetated) fps]: 24 pound UV-stable polypropylene top and bottom nets, 24 pound UV-stable polypropylene corrugated center net, 100% polypropylene fiber matrix.
1. North American Green P550
 2. Or accepted substitution

PART 3 - EXECUTION

3.1 GENERAL

- A. All temporary and permanent erosion and sediment control practices will be maintained and repaired as needed to ensure continued performance of their intended function.
- B. City of Loveland will monitor Contractor's erosion control methods. If the overall function and intent of erosion control is not being met, City of Loveland will require Contractor to provide additional measures as required to obtain the desired results.
- C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.

3.2 PROTECTION OF ADJACENT PROPERTIES

- A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.
- B. In addition to the erosion control measures required on the drawings, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:

1. Vegetated buffer strip around the lower perimeter of the land disturbance.
 - a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.
2. Sediment barriers such as straw bales, erosion logs, and silt fences.
3. Sediment basins and porous landscape detention ponds.
4. Combination of above measures.

3.3 CONSTRUCTION

A. Stabilization of Disturbed Areas:

1. Temporary sediment control measures shall be established within five (5) days from time of exposure or disturbance.
2. Permanent erosion protection measures shall be established within five (5) days after final grading of areas.

B. Stabilization of Sediment and Erosion Control Measures:

1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.
2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.
3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.

C. Stabilization of Waterways and Outlets:

1. All onsite stormwater conveyance channels used by Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.
2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

D. Storm Sewer Inlet Protection: All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.

E. Construction Access Routes:

1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area.
4. Street washing shall be allowed only after sediment is removed in the manner described above.

3.4 DISPOSITION OF TEMPORARY MEASURES

- A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by City of Loveland.
- B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.
- C. Substantial Completion of Erosion Control Measures:
 - 1. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.
 - 2. Maintenance of Erosion Control Measures after Substantial Completion: Contractor shall be responsible for maintaining temporary erosion control measures as specified in the drawings and Contract Documents until such time as work has been accepted by City of Loveland and as specified in Division 1 for Closeout Procedures.

END OF SECTION 312500

SECTION 321200 – FLEXIBLE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Full depth and/or composite hot bituminous pavement (asphalt) over prepared subgrade
- B. Overlay, patch and/or pavement rehabilitation applications for streets, parking lots and other miscellaneous asphalt pavement

1.2 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork
- B. Section 32 13 00 – Rigid Paving

1.3 REFERENCES

- A. Ground Engineering Geotechnical Subsurface Exploration Program, Loveland Sports Park Phase 2 (December 21st, 2017)
- B. Ground Engineering Addendum #1, Alternate Pavement Parameters Loveland Sports Park Phase 2 (February 9th, 2018)
- C. AASHTO T 230: Standard Method of Test of Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures
- D. ASTM C29: Unit Weight and Voids in Aggregate
- E. ASTM C88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- F. ASTM C117: Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
- G. ASTM C128: Specific Gravity Test and Absorption of Fine Aggregate
- H. ASTM C131: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- I. ASTM C136: Sieve or Screen Analysis of Fine and Coarse Aggregates
- J. ASTM D70: Specific Gravity of Semi-Solid Bituminous Materials
- K. ASTM D2726: Bulk Specific Gravity of Compacted Bituminous Mixtures
- L. ASTM D2041: Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
- M. ASTM D4462: Viscosity of Asphalts (Bitumens)
- N. ASTM D2172: Quantities Extraction of Bitumens from Bituminous Paving Mixtures

- O. ASTM D2419: Sand Equivalent Value of Soils and Fine Aggregate
- P. ASTM D290: Bituminous Mixing Plant Inspection
- Q. ASTM D6373: Performance Graded Asphalt Binder
- R. ASTM D692: Course Aggregate for Bituminous Paving
- S. ASTM D1073: Fine Aggregate for Bituminous Paving Mixtures
- T. ASTM 1241: Materials for Soil-Aggregate Subbase, Base and Surface Courses
- U. ASTM D2026: Cutback Asphalt (Slow-Curing Type)
- V. ASTM D2027: Cutback Asphalt (Medium-Curing Type)
- W. ASTM D2028: Cutback Asphalt (Rapid-Curing Type)
- X. ASTM D2950: Density of Bituminous Concrete in Place by Nuclear Methods
- Y. SP-2: Superior Performing Asphalt Pavement System (Superpave) Level 1 Mix Design
- Z. Colorado Department of Transportation
- AA. Colorado Asphalt Pavement Association
- BB. Larimer County construction specifications, standards and details.

1.4 SUBMITTALS

- A. Submit under provisions of Division One Specifications
- B. Record of Work: Maintain record of time and date of placement, temperature, and weather conditions, retain until completion and furnish copy to engineer.
- C. Proposed Design Job Mix Formula for each mixture required by the contract. The mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design.
- D. Test Reports: Proposed Design Job Mix testing shall be performed in a materials laboratory under the direct supervision of; and shall be stamped and signed by a Professional Engineer licensed in the State of Colorado practicing in this field. In addition, the General Contractor shall submit as part of the Proposed Design Job Mix, documents to verify the following:
 - 1. Source of materials
 - 2. Gradation, specific gravity, source and description of individual aggregates and the final blend
 - 3. Aggregate physical properties
 - 4. Source and Grade of the Performance Graded Binder (PG Binder)
 - 5. Proposed Design Job Mix – aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content

6. Required mixing and compaction temperatures
7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
8. Sampling and testing of asphalt concrete mixtures for quality control during paving operations
 - a. Uncompacted asphalt concrete mix
 - i) Asphalt cement content: ASTM D2172 (AASHTO T164)
 - ii) Maximum Specific Gravity: ASTM D2041 (AASHTO T209)
 - b. Compacted asphalt concrete mix
 - i) Bulk density: ASTM D1188 (AASHTO T166)
 - c. Perform at least one test for each day's paving but not less than one test per each 4000 sf of each lift.

1.5 QUALITY ASSURANCE

- A. Materials and installation shall conform to applicable portions of Colorado Department of Transportation (CDOT) and Larimer County construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

- A. For work on public streets or rights-of-way conform to the requirements of Larimer County construction specifications, standards and details for the construction of concrete, curbs, gutters, sidewalks, driveways, roadways, street paving, and other public right-of-way Improvements.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle materials under provisions of Division One Specifications
- B. Transport mixture from mix plant in trucks with tight, clean, smooth, non-sticking compartments. Thinly coat hauling compartments with lime-water mixture, paraffin oil or other approved release agent to prevent sticking. Petroleum distillates such as kerosene or fuel oil are not approved release agents. Elevate and drain compartment of excess solution before loading mix.
- C. Cover to protect from weather and prevent loss of heat
- D. Provide insulated truck beds during temperature below 50 degrees F on long distance deliveries

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply when underlying surface is muddy, frozen or wet
- B. Weather conditions permit pavement to be properly placed and compacted
- C. The hot mix asphalt will be placed only when both the air and surface temperatures are equal to or exceed the temperatures specified in the table below:

CDOT Table 401-3: Placement Temperature Limitations in F

Compacted Layer Thickness (Inches)	Minimum Air and Surface Temp. (Degrees F and rising)	
	Top Layer	Other Layers
1½ or less	60	50
>1½ to 3	50	40
3 to 4	45	35

Air temperature shall be taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Pavement shall be asphalt of the plant hot mix type. Materials and construction shall comply with Section 403 and 702 of the CDOT Standards and Specifications for Road and Bridge Construction.
- B. Tack Coat:
 - 1. SS-1 or CSS-1h
 - 2. AASHTO M208 or M140
- C. Asphaltic Cement:
 - 1. Superpave Performance Graded (PG) binder of PG64-22 or PG58-28 Table 702-1 of CDOT standard section 702
 - 2. Will not be acidic modified or alkaline modified
 - 3. Will not contain any used oils that have not been refined
 - 4. Modifiers will not be carcinogenic
- D. Aggregate for Asphaltic Concrete, General
 - 1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D692
 - 2. Sand, stone, or slag screening: ASTM D1073
 - 3. Percent wear: ASTM C131, less than 45 for aggregates retained in #10 sieve
- E. Base Course Aggregates for Asphaltic Concrete
 - 1. Uncrushed gravel may be used in mixture if it meets design criteria specified
 - 2. Provide uniform quality combined aggregates with a minimum sand equivalent value of 40
 - 3. Provide aggregate in gradations for courses to comply with Class S and SG, Colorado Department of Transportation, ASTM C136
 - 4. A maximum of 20% Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.

- a. RAP shall not be allowed in polymer modified mixes or in the permanent final lift of asphalt.

F. Surface Course Aggregates for Asphaltic Concrete

1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions
2. Provide uniform quality combined aggregate with a minimum sand equivalent value of 50
3. Provide aggregate in gradations for courses to comply with Class SX, Colorado Department of Transportation, ASTM C136.

G. Hydrated Lime for Aggregate:

1. May be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment will conform to ASTM C207, Type N. Residue retained on a No. 200 sieve will not exceed 10% when determined in accordance with ASTM C110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.

- H. Weed Control: First application, "Roundup." Second application, Casoron "W-50" or "G-10" with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Traffic Control Devices

1. Signs.
 - a. Comply with Larimer County standards and specifications for signs within the public right-of-way.
 - b. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by Larimer County. Private property or nonstandard signs will be maintained by the owner. Submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements. All signs shall be 3M-engineer grade reflective sheeting or accepted substitute.
 - c. Traffic/Parking Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick. Facing shall be specified reflective sheeting with standard sign colors based on standard graphics and as shown on the plans.
2. Sign Posts.
 - a. For large signs greater than 12"W x 18"H and for multiple signs of any size mounted on the same post: sign posts shall be two (2) inch by two (2) inch galvanized telespar tube.
 - b. For regular single signs 12"W x 18"H or smaller: sign posts shall be one and one-half (1-1/2) inch by one and one-half (1-1/2) inch galvanized telespar tube.
 - c. Galvanized telespar tube shall have 0.120-inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, all sides over full length, ten (10) feet in length (min).

3. Sign Post Anchor Bases (Stubs). All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4" by 2-1/4" anchor for large posts and 1-3/4" by 1-3/4" anchor for regular posts. Bases shall be embedded a minimum of 36" below finished grade and shall extend 3" above finished grade.
 4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are present which will not properly compact at sign base, install a 6" diameter by 36" deep concrete footing around signs post anchor base for all signs in landscaped areas.
 5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.
- B. Pavement Marking. Specified pavement marking materials shall be used at locations as identified below.
1. Comply with Larimer County standards and specifications for pavement marking within the public right-of-way.
 2. FS TT-P-115, Type I Alkyd, white, blue, yellow and red color paint meeting requirements of CDOT Standard Specification 708. Verify colors and extent of painting prior to painting. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on internal pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on internal drive, road or street pavements.
 3. Furnish paint with a no-pick-up maximum drying time of 20 minutes, when tested according to ASTM D711 using a wet film thickness of 0.015-inch when tested and applied at 77 degrees F.
 4. 3M Stamark 5730 preformed plastic marking material or an accepted substitute shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes in right-of-way. Use of thermoplastic pavement marking is not permitted.

2.3 MIXES/SOURCE QUALITY CONTROL

- A. Determine full depth design mix based upon aggregates furnished
1. Test mix by independent laboratory at Contractor's expense
 2. Grade dependent on temperature during placement
 3. Submit mix designs under provisions of Division One specifications for review and acceptance by Engineer
- B. Submit mix design giving unit weight and to meet following requirements prior to placement of asphalt:

Property	S(75)	SX(75)
Air Voids in Mix, % (N Design)	3.5-4.5	3.5-4.5
Initial Gyrations	7	7
Design Gyrations	75	75
Hveem Stability	28 min	28 min
Voids Filled w/ Asphalt	65-80	65-80

Establish a single percentage passing each sieve size, a single percent of asphalt and a mix temperature. Maintain job mixes within following percentages of design mix:

Aggregates:	
¾" and larger	± 6%
#4 to #8	± 5%
#30	± 4%
#200	± 2%
Asphalt Content Tolerance	± 0.3%
Discharge Mix temp	± 20° F

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Establish and maintain required lines and elevations. Provide grade and location stakes under this section as required for asphaltic concrete paving work.
- B. Operate heavy, rubber-tired front loader over subgrade of paved areas. Where soft spots occur, remove loose materials and replace with Class 6 road base aggregate complying with CDOT standards compacted to level of subgrade.

3.2 PREPARATION

- A. Prepare subgrade under provisions of Section 31 00 00
- B. Loose and Foreign Material
 1. Remove loose and foreign material from compacted subgrade surface immediately before application of paving. Clean surface with mechanical sweeper, blowers, or hand brooms, until surfaces are free from dust
- C. Weed Control
 1. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow "Round-up"

to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.

2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.
4. Do not apply within 20 feet of trees or shrubs

D. Tack Coat

1. Apply in similar manner as prime coat, except as modified
2. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphaltic concrete or portland cement concrete and surfaces
3. Apply at rate of 0.05 to 0.15 gallons per square yard of surface
4. Apply tack coat by brush to contact surfaces of curbs, gutters, catch basins, and other structures projecting into or abutting asphaltic concrete pavement
5. Allow surfaces to dry until material is at condition of tackiness to receive pavement
6. Where asphaltic concrete will adhere to surface, tack coat may be eliminated by Engineer

3.3 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to minimum depth of 1 ½-inches, or as indicated on the plans.
2. Mill to a uniform finished surface free of gouges, grooves, and ridges of more than ¼ inch depth.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.4 RING/FRAME ADJUSTMENTS

- A. Set ring/frames of subsurface structures to final grade as a part of this work.
- B. Placing Ring/Frames
 - 1. Surround ring/frames set to elevation with a ring of compacted asphalt concrete base prior to paving
 - 2. Place asphalt concrete mixture up to 1-inch below top of ring/frame, slope to grade, and compact by hand tamping
- C. Adjust frames to proper position to meet paving
- D. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations
- E. Set ring/frames to grade, flush with surface of adjacent pavement

3.5 PREPARING THE MIXTURE

- A. Comply with ASTM D995 for material storage, control, and mixing and for plant equipment and operation
- B. Stockpile
 - 1. Keep each component of the various sized combined aggregates in separate stockpiles
 - 2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation
- C. Heating
 - 1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
 - 2. Use lowest possible temperature to suite temperature viscosity characteristics of asphalt
 - 3. Do not exceed 350 degrees F
- D. Aggregate
 - 1. Heat-dry aggregates to acceptable moisture content
 - 2. Deliver to mixer at recommended temperature to suite penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture
 - 3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements
- E. Mix aggregate and asphalt cement to achieve 90-95 percent coated particles for base mixtures and 85-90 percent coated particles for surface mixture, per ASTM D2489

3.6 EQUIPMENT

- A. Bituminous Pavers:

1. Self-propelled, spreads without tearing surfaces, equipped with an activated screed assembly, heated if necessary, controls pavement edges to true lines without use of stationary forms and capable of spreading and finishing the asphalt plant mix material in widths applicable to the typical sections and thicknesses shown in the contract documents.
2. Pavers used for roadway shoulders, recreational paths and similar construction will be capable of spreading and finishing the courses of asphalt plant mix material in width shown in the contract documents.
3. Pavers will be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor will be constructed to operate from either or both sides of the paver and will be capable of working with the following devices:
 - a. Ski-type device at least 30 feet in length
 - b. Short ski or short shoe
 - c. At least 5,000 feet of control line and stakes
4. The controls will be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent.
5. Manual operation will be permitted:
 - a. For constructing irregularly shaped or minor areas
 - b. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. However, if specified surface tolerances cannot be achieved, paving operations will be suspended until satisfactory correction, repairs of equipment replacements are made.

B. Rolling Equipment

1. Steel-wheel roller: Self-propelled, contact pressure of 250 to 350 psi per inch of width of roller wheel, equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking
2. Pneumatic-tired rollers: Self-propelled, contact pressure under each tire of 85 to 110 psi, wheels spaced so that one pass will accomplish one complete coverage equal to rolling width of machine, oscillating wheels. Remove and replace immediately tires picking up fines

- C. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools

3.7 PLACING THE MIX

- A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine
- B. Complete placement over full width of section on each day's run
- C. Spread mixture at minimum temperature specified by CDOT Table 401-5 for the specific binder used in the asphalt mix:
 1. PG 64-22: 320 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
 2. PG 58-28: 275 F minimum mix discharge temperature, 235 F minimum delivered mix temperature

3. The maximum mix discharge temperature will not exceed the minimum discharge temperature by more than 30 F.
 4. Delivered mix temperature will be measured behind the paver screed
 5. Hot asphalt mixture will be produced at the lowest temperature with the specified temperature range:
 - a. producing a workable mix and provides for uniform coating of aggregates, in accordance with AASHTO T195
 - b. allowing the required compaction to be achieved
- D. Inaccessible and small areas may be placed by hand
- E. Conform to the grade, cross section, finish thickness, and density indicated.
- F. Lift Thickness
1. Place in multiple lifts. Place asphalt in lifts such that each compacted lift thickness is no less than 2.0" thick and no greater than 3.0" thick. Top lift to be 2" thick.
 2. Typical Lift Thickness Sequencing:

Final Asphalt Section Required (inches)	No. of Lifts	Thickness of each Lift (inches) from bottom to top lift
2"	1	2
3"	1	3
4"	2	2-2
5"	2	3-2
6"	3	2-2-2
7"	3	3-2-2
8"	3	3-3-2
9"	4	3-2-2-2
10"	4	3-3-2-2
>10	Review with Engineer	

G. Paver Placing

1. Unless otherwise directed, being placing along centerline of areas in crowned section and at high side on one-way slope and in direction of traffic flow
2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips
3. Complete base courses before placing surface courses
4. Place mixture in continuous operation as practicable

H. Hand Placing

1. Spread, tamp, and finish mixing using hand tools in areas where machine spreading is not possible as acceptable to Engineer
2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature

I. Joints

1. Construct transverse joint at right angles to centerline when operations are suspended long enough for mixture to chill
 2. Construct joints to have same texture, density, and smoothness as adjacent sections of asphalt concrete course
 3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat
 4. Offset transverse joints in succeeding courses not less than 24 inches
 5. Cut back edge of existing pavement or previously placed course to expose an even, vertical surface for full course thickness
 6. Offset longitudinal joints in succeeding courses not less than 6 inches
 7. When the edges of longitudinal joints are irregular, honeycombed or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness
 8. Wearing course constructed in even number of strips; place 1 longitudinal joint on centerline of road
 9. Wearing course constructed in odd number of strips; place the centerline of 1 strip on centerline of road
- J. Gutter: Finish surface high adjacent to concrete gutter so when compacted surface is slightly higher than edge of curb and flashing

3.8 COMPACTING THE MIX

- A. All paving will be compacted to 94 +/- 2% of Maximum Theoretical (RICE) density, CP-51 or AASHTO T209: Maximum Specific Gravity of Bituminous Paving Mixtures, as determined by ASTM D 2950. RICE values will be used in calculating Relative Compaction according to CP-44 or AASHTO T166.
- B. Provide pneumatic and steel-wheel type rollers to obtain the required pavement density, surface texture and rideability
- C. Begin rolling operations when the mixture will bear weight of roller without excessive displacement and complete as quickly as possible after placement occurs.
- D. Compaction operations will be continuous until the required density is achieved or the density requirements are not met and the mix temperature falls below 185° F or there is obvious surface distress or breakage. Minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on the asphalt binder supplier documentation kept on file at the jobsite.
- E. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set
- F. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers
- G. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs
- H. Do not roll centers of sections first under any circumstances

I. Breakdown Rolling

1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge
2. Operate rollers as close as possible to paver without causing pavement displacement
3. Check crown, grade, and smoothness after breakdown rolling
4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling

J. Second Rolling

1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction
2. Continue second rolling until mixture has been thoroughly compacted

K. Finish Rolling

1. Perform finish rolling while mixture is still warm enough for removal of roller marks by combination of steel and pneumatic rollers
2. Continue rolling until roller marks are eliminated and course has attained specified density, and required surface texture and surface tolerances
3. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness

L. Patching

1. Remove and replace defective areas
2. Cut-out and fill with fresh, hot asphaltic concrete
3. Remove deficient areas for full depth of course
4. Cut sides perpendicular and parallel to direction of traffic with edges vertical
5. Apply tack coat to exposed surfaces before placing new asphaltic concrete mixture
6. Compact by rolling to specified surface density and smoothness

3.9 JOINING TO EXISTING WORK

- A. Cut sides vertically and apply tack coat to exposed asphalt surfaces before placing new pavement. Meet existing thickness of surface and base courses, but not less than specified for new work.
- B. All joins shall be compacted to 92.0% +/- 2.0% of RICE, taken fully on each side of joint, every 200 lineal feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T166.

3.10 FIELD QUALITY CONTROL

- A. City of Loveland will engage a certified testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction in accordance with Division One Specifications.

- B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency advance notification to schedule tests.
- C. Testing Agency will test in-place pavement for density and thickness.
- D. Asphalt density testing:
 - 1. Every one-hundred fifty (150) lineal feet per driving lane.
 - 2. Every 2,000 square feet of parking lot
 - 3. Densities shall be between ninety-two percent (92%) and ninety-six percent (96%) of the RICE unit weight
- E. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections
- F. The Contractor will core the pavement as required by the testing agency for field density tests in accordance with AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with ASTM D 2950.
 - 1. Testing agency will take not less than 4-inch diameter pavement specimens
 - 2. At the testing agency's discretion, cores may be required at the beginning of placement of each pavement layer or change of mixture materials or gradation.
 - 3. Untested areas during placement will require cores to be taken to verify compaction
 - 4. Contractor to repair holes from test specimens
- G. For each completed course or from locations directed by the testing agency, and at a minimum, a representative asphalt pavement sample shall be taken from the first one thousand (1,000) tons, and all mix properties shall be verified. The percent voids filled with asphalt cement, Hveem stability, and Lottman shall be verified at a minimum of every ten-thousand (10,000) tons. Asphalt testing shall comply with ASTM D1559. Two copies of all test reports shall be submitted directly to the Engineer.
- H. Acceptable density of in-place course materials is between 92 and 96 percent of the recorded laboratory RICE unit weight. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements
- I. Thickness: Variations from drawings
 - 1. Base course: 1/4-inch +
 - 2. Remove and replace paving less than minimum thickness
- J. Grade Tolerance: ± 0.1 feet
- K. Surface Smoothness
 - 1. Test using a 10-foot straight edge applied parallel to direction of drainage
 - 2. Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact
 - 3. Do not permit pockets or depressions where water may pool

4. Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to Engineer

L. Inspection: The work of this section is subject to the inspection and approval of the engineer and/or owner. The following inspections are required:

1. Protection of adjacent property
2. Staking and establishment of elevations
3. Establishment and compaction of subgrade
4. Placement and compaction of bituminous base course and wearing surface
5. Final inspection
6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

3.11 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of Engineer

3.12 PROTECTION OF FINISHED WORK

- A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and in no case sooner than 6 hours
- B. Provide barricades and warning devices as required to protect pavement and the general public

3.13 WARRANTY

- A. Provide installer's 2-year written warranty endorsed by the contractor warranting the pavement from creeping, shoring, cracking, softening, settling, ponding and other defects due to improper placing or defective materials. Replace defective materials upon notification by the owner in accordance with the requirements of the original work.

3.14 SCHEDULE OF MIX PLACEMENT:

- A. Refer to Drawings for asphalt thickness and subgrade requirements.

END OF SECTION 321200

SECTION 321300 – RIGID PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.2 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork

1.3 REFERENCES

- A. Ground Engineering Geotechnical Subsurface Exploration Program, Loveland Sports Park Phase 2 (December 21st, 2017)
- B. Ground Engineering Addendum #1, Alternate Pavement Parameters Loveland Sports Park Phase 2 (February 9th, 2018)
- C. AASHTO M171 – Sheet Materials for Curing Concrete
- D. ACI 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
- E. ACI 301 – Specifications for Structural Concrete for buildings
- F. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- G. ACI 305/305R – Hot Weather Concreting
- H. ACI 306/306R – Cold Weather Concreting
- I. ACI 308 – Standard Practice for Curing Concrete
- J. ASTM A1064 – Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete
- K. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- L. ASTM C31 – Making and Curing Concrete Test Specimens in the Field
- M. ASTM C33 – Concrete Aggregates
- N. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens
- O. ASTM C94 – Ready Mix Concrete
- P. ASTM C143 – Test Method of Slump of Hydraulic Cement Concrete

- Q. ASTM C150 – Portland Cement
- R. ASTM C260 – Air-Entraining Admixtures for Concrete
- S. ASTM C309/AASHTO M148 – Liquid Membrane-Forming Compounds for Curing Concrete
- T. ASTM C494 – Chemical Admixtures for Concrete
- U. ASTM C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- V. ASTM D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- W. ASTM D6690 – Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- X. ASTM D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
- Y. ASTM D1752 – Preformed Sponge Rubber Cork Expansion and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- Z. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- AA. Larimer County construction specifications, standards and details.

1.4 SUBMITTALS

- A. Provide under provisions of Division One Specifications
- B. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds
 - 1. Existing data on proposed design mixes, certified and complete
 - 2. Submit reports of field quality control testing

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, Conform materials and installation to applicable portions of Colorado Department of Transportation, and the Larimer County construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

- A. For work on public streets or rights-of-way conform to the requirements of Larimer County construction specifications, standards and details for the Construction of Curbs, Gutters, Sidewalks, Driveways, Street Paving, and other public right-of-way Improvements.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- C. Obtain cementitious materials and aggregate from same source for all work

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle materials under provisions of Division One Specifications
- B. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover
- C. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight
- D. Prepare a delivery ticket for each load of ready-mixed concrete
- E. Contractor shall submit tickets for all concrete delivered to site:
 - 1. Quantity delivered
 - 2. Actual quantity of each material in batch
 - 3. Outdoor temp in the shade
 - 4. Time at which cement was added
 - 5. Numerical sequence of the delivery
 - 6. Quantity of water that can be added in the field based on mix design
 - 7. Free moisture in fine and coarse aggregate in percent by weight
 - 8. Temperature of batch

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen
- B. Protect concrete from rapid loss of moisture during hot water placement

PART 2 - PRODUCTS

2.1 MATERIALS

A. Form Materials

- 1. Form Materials: Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
- 2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
- 3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete
- 4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise

B. REINFORCEMENT

- 1. Where reinforcement is specified herein or indicated on the plans:
 - a. Bars: ASTM A615, Grade 60

- b. Reinforcing Welded Wire Fabric (WWF): ASTM A1064, steel, 16 gage minimum
 - i) Furnish in flat sheets
- c. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish

2.2 ACCESSORIES

- A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane
- B. Joint Sealers: Polyurethane base, elastomeric, self leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions
- C. Sheet Materials: AASHTO M171, 4 mil
- D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethylene foam; Texmastic "vinylex 3600," Sonneborn "Sonoflex F," or accepted substitutions

2.3 CONCRETE MIX

- A. Comply with ASTM C94
- B. Maximum Coarse Aggregate Size: 1-inch
- C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete
- D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.44
- E. Slump: 4-inch maximum
 - 1. May be increased to 4.5 inches for hand work, acceptable to Engineer
 - 2. As low as possible consistent with proper handling and thorough compaction
- F. Volumetric Air Content: $4.5\% \pm 1\%$ after placement for 1-inch aggregate
 - 1. Vary air content with maximum size aggregate, ASTM C94, Table 3.
- G. Strength: Compressive strength as determined by ASTM C39, 5,000 psi minimum at 28 days
- H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded
- I. Adjust mix as required to meet specifications
- J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 25 percent Class C or Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:
 - 1. The loss on ignition shall not exceed 3.0 percent
 - 2. The CaO in Class F fly ash shall not exceed 18 percent

K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification

1. Include a water reducing admixture
2. Calcium chloride content shall not exceed 0.05% of the cement content by weight

2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Provide under provisions of Division One Specifications
- B. Submit proposed mix design to Engineer for review prior to commencement of work
- C. Tests on cement and aggregates will be performed to ensure conformance with specified requirements
- D. Test samples in accordance with ACI 301.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads
- B. Verify gradients and elevations of base are correct
- C. Check completed formwork for grade and alignment to the following tolerances:
 1. Top of forms not more than 1/8-inch in 10 feet
 2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.2 PREPARATION

A. Subgrade

1. Prepare subgrade in accordance with Section 31 00 00 – Earthwork
2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete
3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Section 02300
4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high
5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete

B. Frame Adjustment

1. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement for concrete collars
2. Set frames of structures in full grout bed to provide bearing. Set to final grade

3. Form construction joints and blockouts as indicated on drawings

3.3 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete

1. Transporting of mixed concrete shall conform to ACI 305R
2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling
3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer
5. Provide delivery ticket and comply with delivery requirements of this section

B. Forming

1. Place and secure forms to correct location, dimension, profile, and gradient
2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement
3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete
4. Oil forms prior to concrete placement
5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement
6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the drawings
7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face
8. Backfill behind forms as required to prevent water from entering subgrade

C. Reinforcement

1. Place bar or WWF reinforcement at mid-height of slabs-on-grade or as shown on the drawings
 - a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire
 - b. Support with metal chairs, brick or stone is unacceptable
2. Hold all tie and marginal dowels in proper position by sufficient supports or pins
3. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip
4. Interrupt reinforcement at expansion joints
5. Place dowels to achieve pavement and curb alignment as detailed.
6. Provide doweled joints inch at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement
7. Grease dowels on one side of joints with caps on greased end

D. Placing concrete

1. Place concrete in accordance with ACI 301
2. Lightly moisten subgrade or base course immediately before placing concrete.
3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed
4. during concrete placement
5. Deposit concrete near final position. Minimize segregation and damage to subgrade
6. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials
7. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs
8. Do not place concrete in forms that has begun to set
9. Do not place more concrete in one day than can be finished before dark the same day
10. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified
11. Walks: Construct sidewalks with a minimum thickness of 4-inch. Tool edges to rounded profile and finish as specified or as shown on the drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated

E. Cold weather concreting

1. Conform to ACI 306/306R, except as modified herein
2. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

3. Do not place heated concrete which is warmer than 80 degrees F
4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place
5. Do not allow concrete to cool suddenly

F. Hot weather concreting

1. Conform to ACI 305/305R, except as modified herein
2. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection
3. Do not allow concrete temperature to exceed 70 deg F at placement
4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture
5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4

G. Joints

1. Provide concrete joints per CDOT Standard Details
2. Sidewalk and pavement
 - a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut
 - b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 100 feet.
 - c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length
3. Curb and Gutter
 - a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.
 - b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.
 - c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.
4. Place expansion joint filler between paving components and buildings or other appurtenances at temperatures above 50 deg F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
5. Provide keyed joints as indicated in details.

H. Finishing

1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish
4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted
5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.
6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic
7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface
9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.

10. Direction of Texturing:
 - a. Curb and Gutter: At right angles to the curb line
11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Engineer.

I. Joint sealing

1. Seal joints and clean concrete prior to opening to traffic.
2. Seal all expansion joints.
3. Separate concrete from other structures with 3/4-inch thick joint filler.
4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.

J. Curing and protection

1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury
2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions
3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved

3.4 FIELD QUALITY CONTROL

- A. Comply with Division One Specifications - Quality Assurance: Field inspections and testing
- B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide testing agency advance notification to schedule tests.
- C. Tolerances
 1. Division One Specifications - Quality Assurance: Tolerances
 2. Maximum Variation of Surface Grade: 1/4- inch in 10 ft
 3. Maximum Variation from True Alignment: 3/8-inch in 10 ft
- D. Take cylinders and perform slump and air entrainment tests as required by Division One Specifications in accordance with ACI 301. Unit weight and mix temperature will also be taken
- E. The first three loads will be tested for slump and air content. If any one test fails to meet requirements, that load will be rejected and tests will continue on each load until three consecutive loads meet requirements. Thereafter, five concrete test cylinders will be taken for every 75 cu yds or less cu yds of concrete placed each day

- F. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents
- G. One slump and air entrainment test will be taken for each set of test cylinders taken
- H. Cylinders will be tested as follows: 2 at 7 days, 2 at 28 days and one at a later date, if necessary, as directed by the Engineer
- I. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken
- J. Thickness of fresh concrete may be checked by Owner at random. Coring will be conducted in accordance with Larimer County requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for portland cement concrete paving as specified in the following table.

CONCRETE PAVEMENT DEFICIENCY	
Deficiency in Thickness (Determined by Cores) INCHES	Proportional Part of Contract Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

Note: When thickness of pavement is deficient by more than one inch, and judgment of the Engineer is that area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

- K. Failure of Test Cylinders or Coring Results: Engineer may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness

3.5 SCHEDULE OF CONCRETE

- A. See plans for concrete thicknesses and subgrade preparation.

3.6 SCHEDULE OF CONCRETE REINFORCEMENT

- A. Rebar reinforcement required for all cross pans. Reinforce all cross pans in conformance with Larimer County standards and specifications.
- B. Trash pad, dumpster locations, truck areas and access drive lanes: 8-inch thick concrete with #4 rebar, 12-inches on center, each way, three inches clear on all sides.

END OF SECTION 321300

SECTION 321540 – SOFT SURFACE GRAVEL PATH

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install:
 - 1. Stabilized gravel path material.

1.2 RELATED SECTIONS AND DOCUMENTS

- A. Section 310000: Earthwork.
- B. Section 329113: Fine Grading and Soil Preparation.
- C. Section 329219: Seeding.
- D. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.3 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Gravel Materials: Subject to inspection and acceptance. Provide source location and 5 lb. sample prior to delivery to site, and sieve analysis.
 - 2. Inspection will be made periodically during path installation, and at project completion and end of warranty period.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Stockpile delivered gravel near path location.
- B. Material will be inspected upon delivery to site.
- C. Immediately remove unacceptable material from site.

1.5 PROJECT CONDITIONS

- A. Visit site to determine existing conditions.
- B. Path construction to precede seeding and planting operations.

1.6 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gravel Materials:

1. Class 6 material. Submit sample for approval.
2. Decomposed Granite.
 - a. Sand-crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. CDOT Class 6 Roadbase (beige color) or approved equal. Gradations requirements shall be as follows:
Crushed Stone Sieve Analysis Percentage of Weight Passing a Square Mesh sieve;
AASHTO T11-82 and T2782.

U.S. Sieve No.	Percent Passing by Weight
3/4"	100
1/2"	75-85
#4	50-65
#8	40-55
#16	35-45
#30	25-35
#50	15-25
#100	12-20
#200	5-12

PART 3 - EXECUTION

3.1 INSPECTION

- A. Visit site to determine existing conditions.
- B. Centerline of path to follow existing graded alignment per plans. Obtain Landscape Architect approval for any deviations.
- C. Grades: Verify grades of ADA accessible path to not exceed 8%.

3.2 PREPARATION

- A. Existing Utilities: Protect from damage any existing utilities in or near the project area.
- B. General: Do not perform work when existing site conditions will not provide satisfactory results.
- C. Clearing and Grubbing: Cut and remove woody or herbaceous vegetation within the path area.
Haul debris off-site.

- D. Scrape 4" deep trail bed.
- E. Grade subgrade level and compact with sheepsfoot roller to 95% optimum density, in accordance with AASHTO T-99. Contractor is not required to scarify and re-compact the next 6" below this sub-grade level.
 - 1. Inspect exposed surface for unsuitable soil, areas of loose or soft soil, disturbed or moist soils.
 - 2. Remove all soft, yielding subgrade material and backfill with 1 1/2" pit run.
- F. Excavated sections and adjacent areas shall be reasonably smooth, compacted, and free from irregular surface changes.

3.3 INSTALLATION

- A. Compacted Gravel Trail:
 - 1. Spread thoroughly mixed portions of gravel uniformly and in even stream along trail bed. Provide stabilizer as specified by manufacturer.
 - 2. Rake crusher fines to uniform 5"-6" with 2% cross slope, per details.
 - 3. Backfill excavation to ultimate trail edge with scraper spoils, using backfill to hold edge of gravel crusher fines in place.
 - 4. Immediately roll gravel material and excavated area with self-propelled, vibratory roller of sufficient weight to compact crusher fines into smooth firm surface. Rolling shall continue until all material is firmly locked and keyed together. The appearance and surface shall be uniform with all ridges removed. Surface shall not vary more than 1/2" when measured with a ten foot straight edge applied parallel to the centerline. Correct any variation by loosening, reshaping and re-rolling. When finished, compacted trail shall be a minimum of 4" deep in all locations.
 - a. In any areas where there are underground pipes, use extreme caution when compacting trail to protect pipe. Discuss alternative compaction methods with Landscape Architect prior to execution for approval if pipe hazard is anticipated.
 - 5. At completion of surfacing, remove excess spoils from along trail edge and deposit on site as directed by Landscape Architect.
 - 6. Rake along all trail edges to ensure finished appearance and positive drainage away from trail and into new drainage structures or swales.
 - 7. Do not use a vibratory plate compactor or a vibration function on a roller as vibration separates large aggregate particles.
 - 8. Do not begin compaction for 6 hours after placement and not longer than 48 hours.

3.4 CLEANING

- A. General: Contractor shall be responsible for daily removal of mud and debris from road surfaces on a daily basis.

3.5 PROTECTION

- A. The Contractor shall be responsible for making a reasonable effort to protect the work from vandalism. If barricading or signage is necessary, the Contractor shall request such from the Owner. Owner shall provide any necessary barricading or signage. Any vandalism shall be brought to the attention of the Owner.

END OF SECTION 321540

SECTION 323129 – WOOD FENCE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. New fencing as indicated on the drawings including post footings and all related accessories.

1.2 QUALITY ASSURANCE

- A. Reference Standards: All wood materials shall comply with standards and specifications of the International Fence Industry Association.

PART 2 - PRODUCTS

2.1 FENCING MATERIALS

- A. Rails and Posts: #1 Grade pressure treated peeled posts (6" dia.) and rails (3 1/2" dia.).
- B. Wire Mesh: 11 gauge 2"x2" mesh.
- C. Concrete: Concrete designed to have a minimum compressive strength of 3,000 psi at 28 days.

2.2 FINISH

- A. Wire mesh to be powder coated black.

PART 3 - EXECUTION

3.1 LAYOUT

- A. Contractor shall set all fencing to alignment as indicated on drawings. Final layout to be approved in the field with Landscape Architect.

3.2 INSTALLATION OF FENCING AND OTHER FENCING MATERIALS

- A. Workmanship: The completed fence shall be plumb, both in line and transverse to the fence and straight. Details of construction not specified shall be performed in keeping with good standard fencing practice.
- B. Concrete: Set all posts in concrete per details. Allow all posts to set at least seven (7) days before rails and wire fabric are installed.
- C. Line and Terminal Posts: Space line posts as required by length of rails and set in concrete as detailed. Slope top of footing from posts out to edge approximately 1" to match finish grade at edges. Provide smooth troweled finish on all footings.

- D. Rails: Set rails as nearly parallel to the finish grade as possible and at the specified height of fence.
In the case of sloping grades, the rails shall be sloped uniformly parallel to the finish grade as nearly as possible and in a manner to prevent any abrupt changes in elevation of the rails.

END OF SECTION 323129

SECTION 328400 – IRRIGATION

PART 1 – GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:
 - 1. Procurement of all applicable licenses, permits, and fees
 - 2. Coordination of Utility Locates ("Call Before You Dig").
 - 3. Connection to electrical power supply for the irrigation control system.
 - 4. Maintenance period.
 - 5. Sleeving for irrigation pipe and wire.

1.2 RELATED WORK:

- A. Division 1-General Requirements:
 - 1. Section 013300 – Submittal Procedures.
 - 2. Section 017700 - Closeout Procedures.
 - 3. Section 017839 – Project Record Documents.
- B. Division 32-Site Work:
 - 1. Section 329113 - Fine Grading and Soil Preparation.
 - 2. Section 329219 - Seeding.
 - 3. Section 329100 – Landscape Maintenance.
 - 4. Section 329300 - Plants.

1.3 SUBMITTALS:

- A. Submit samples under provisions of Section 013300-Submittals.
 - 1. Deliver four (4) copies of all submittals to the Owner's Representative within 10 working days from the date of Notice to Proceed. Provide information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed for different components and labeled with the specification section number and the name of the component. Submittals must be made for all the components on the material list. Indicate which items are being supplied on the catalog cut sheets when multiple items are shown on one sheet. Submittal package must be complete prior to being reviewed by the Owner's Representative. Incomplete submittals will be returned without review.
- B. Materials List: Include sleeving, pipe, fittings, mainline components, sprinkler and bubbler components, drip irrigation components, control system components, shop drawings and all other components shown on the drawings and installation details or described herein. Components such

as pipe sealant, wire, wire connectors, ID tags, etc. must be included. Quantities of materials need not be included.

- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
- D. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

1.4 RULES AND REGULATIONS:

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.5 DEMOLITION

- A. Remove existing sprinklers, valves, automatic controllers, and other irrigation components indicated on the drawings. Remove items in a manner that minimizes damage to the components. Deliver only salvageable items to a City of Loveland Parks Department Representative. The Contractor shall dispose of all other items.
- B. Existing pipelines shall be abandoned in place. If an existing pipeline is encountered during the installation of a new pipeline, a section of the existing pipeline shall be cut and removed. Remove two (2) feet of the existing pipeline on either side of the new pipeline.

1.6 TESTING:

- A. Notify the Engineer and Owner's Representative five days in advance of testing.
- B. Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Engineer or Owner's Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.

E. Volumetric Leakage Test:

1. Cap risers of mainline components for volumetric pressure tests. Backfill to prevent pipe from moving under pressure. Expose couplings and fitting.
2. Purge all air from the pipeline before test.
3. Subject mainline pipe and lateral pipe to 120 PSI for two hours. Maintain constant pressure. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
4. Owner to be on site to witness the test from start of filling line, verifying which valves are open and closed, then monitoring the test itself.
5. Cement or caulking to seal leaks is prohibited.

F. Hydrostatic Pressure Test:

1. Close tightly isolation gate valves and sprinkler lateral isolation gate valves on mainline for tests. Backfill to prevent pipe from moving under pressure.
2. Test each section of pipe between isolation gates valves on the mainline pipe separately.
3. Purge all air from the pipeline before test. Attach pressure gauge to pipeline in test section. Attaching pressure gauge immediately downstream of one sprinkler lateral isolation gate in the test section is acceptable.
4. Subject mainline pipe to the anticipated operating pressure of 90 PSI for two hours. Observe pressure loss on pressure gauge. If pressure loss is greater than 2 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pressure loss is equal to or less than 2 PSI.
5. Cement or caulking to seal leaks is prohibited.
6. If Hydrostatic Pressure Test cannot be passed, test pipe using Volumetric Leakage Test.

G. Operational Test:

1. Activate each remote control valve in sequence from controller. The Engineer or Owner's Representative will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests; replace components, and correct deficiencies at no additional cost to the Owner.

H. Central Control System Acceptance Test:

1. Upon completion of construction, a System Acceptance Test must be passed.
2. Following construction completion and a Review by the Engineer, an evaluation period will begin. After 30 days of continuous service without major system problems, the system will be accepted and the guarantee/warranty period will begin. If at any time during the 30-day evaluation period, a major system problem occurs, the source of the problem will be determined and corrected and the 30-day evaluation period will start again. Equipment will not be accepted until such time as the System Acceptance Test is passed.

3. If successful completion of the System Acceptance Test is not attained within 90 days following commencement of the evaluation period, the Engineer/Landscape Architect/Owner's Representative has the option to request replacement of equipment, terminate the order, or portions thereof, or continue with the System Acceptance Test. These options will remain in effect until such time as a successful completion of the System Acceptance Test.
4. Final payment will be made after successful completion of the System Acceptance Test.

I. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod, or appurtenances. Repeat the test until the manufacturer's guidelines are met.

1.7 CONSTRUCTION REVIEW:

- A. The purpose of on-site reviews by the Engineer or Owner's Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.
1. Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the Engineer or Owner's Representative as required by these specifications.
 2. Impromptu reviews may occur at any time during the project.
 3. A review will occur at the completion of the irrigation system installation and Project Record (As-Built) Drawing submittal.

1.8 GUARANTEE/WARRANTY AND REPLACEMENT:

- A. The purpose of this guarantee/warranty is to insure that the Owner receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
1. For a period of one year from commencement of the formal maintenance period (project acceptance), guarantee/warranty irrigation materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within one business day of notification from the Engineer or Owner's Representative.
 2. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
 3. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

PART 2 – MATERIALS

2.1 QUALITY:

- A. Use materials, which are new and without flaws or defects of any type, and which are the best of their class and kind.

2.2 SUBSTITUTIONS:

- A. Acceptable equipment manufacturers are Hunter rotor sprinklers (ADS or 36S), Rain Bird remote control valves (PESB- Raw), Rain Bird quick coupler 44NP, Matco one-piece schedule 80 ball valve, Spears pre-filled dri-splice DS-400 wire connectors, Rain Bird 1804 pop-up spray heads, Harco rubber gasketed ductile iron fittings, Amatek Commercial valve boxes, or approved equal. Rain Master Eagle Plus iCentral controllers, no substitutions. Alternative equipment must be approved by the Engineer and Owner's Representative prior to bidding. The Contractor is responsible for making any changes to the design to accommodate alternative equipment.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

2.3 SLEEVING:

- A. Install separate sleeve (one for pipe and one for wire) beneath paved areas to route each run of irrigation pipe or wiring bundle.
- B. Sleeving material beneath pedestrian pavements shall be PVC Class 200 pipe with solvent welded joints.
- C. Sleeving beneath drives and streets shall be PVC Class 200 pipe with solvent welded joints.
- D. Sleeving diameter: as indicated on the drawings and installation details or equal to twice that of the pipe or wiring bundle.

2.4 PIPE AND FITTINGS:

- A. Mainline Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
 - 2. Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters, which are not manufactured in Class 200.
 - 3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe with a nominal diameter greater than or equal to **3-inches**. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use rubber-gasketed deep bell ductile iron fittings conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by the pipe manufacturer.
 - 4. Use solvent weld pipe for mainline pipe with a nominal diameter less than 3-inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use Uni-Weld 7300 cleaner and Turf Tite solvent cement only.

B. Lateral Pipe and Fittings:

1. Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters, which are not manufactured in Class 200.
 - a. Use solvent weld pipe for lateral pipe. Use UV radiation resistant Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use Uni-Weld 7300 cleaner and Turf Tite solvent cement only.
2. For drip irrigation laterals downstream of zone control valves, use UV radiation resistant polyethylene pipe manufactured from Prime Union Carbide G-resin 7510 Natural 7 manufactured by Union Carbide or a Union Carbide Licensee with a minimum of 2% carbon black.
 - a. Use PVC/compression line fittings compatible with the drip lateral pipe. Use tubing stakes or landscape fabric staples to hold above-ground pipe in place.

C. Specialized Pipe and Fittings:

1. Copper pipe: Use Type "K" rigid conforming to ASTM Standard B88.
 - a. Use wrought copper or cast bronze fittings, soldered or threaded per the installation details. Use a 95% tin and 5% antimony solder.
2. Galvanized steel pipe: Use Schedule 40 conforming to ASTM Standard A53.
 - a. Use galvanized, threaded, standard weight, malleable iron fittings.
3. Ductile iron pipe: Use Class 50 conforming to ANSI A21.51 (AWWA C151). Use a minimum of Class 53 thickness pipe for flanged piping.
 - a. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
4. Use a dielectric union wherever a copper-based metal (copper, brass, bronze) is joined to an iron-based metal (iron, galvanized steel, stainless steel).
5. Assemblies calling for flanged connections shall utilize stainless steel studs and nuts and rubber gaskets.
6. Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings.
7. Joint sealant: Use only Teflon - type tape on plastic threads and use nonhardening, nontoxic pipe thread sealant formulated for use on metal for metal threaded connections and approved by the pipe fitting manufacturer.

D. Thrust Blocks:

1. Use thrust blocks for fittings on pipe greater than or equal to **3-inch** diameter or any diameter rubber gasketed pipe.
2. Use 3,000 PSI concrete.
3. Use 2-mil plastic.
4. Use No. 4 Rebar wrapped or painted with asphalt tar based mastic coating.

E. Joint Restraint Harness:

1. Use a joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.

2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
3. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials, which are zinc plated or galvanized.
4. Use on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.

2.5 MAINLINE COMPONENTS:

- A. Main System Shutoff Valve: as presented in the installation details and in compliance with local code.
- B. Winterization Assembly: as presented in the installation details and in compliance with local code.
- C. Backflow Prevention Assembly: as presented in the installation details and in compliance with local code.
- D. Flow Sensor Assembly: as presented in the installation details.
- E. Isolation Gate Valve Assembly: as presented in the installation details. Install a separate valve box each assembly.
- F. Quick Coupling Valve Assembly: double swing joint arrangement as presented in the installation details.
- G. Wye-Strainer Assembly: as presented in the installation details. Install a separate valve box each assembly.

2.6 SPRINKLER IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: as presented in the installation details. Use wire connectors (Spears DS-400) to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box for each assembly.
- B. Sprinkler Assembly: as presented in the drawings and installation details

DRIP IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Drip Laterals: as presented in the installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- B. Zone Control Valve Assembly: as presented in the installation details. Install a separate box for each assembly.

C. Drip Emitter Assembly:

1. Barb-mounted, vortex and/or pressure compensating emitter device as presented in the installation details. The device shall be RainBird XB 0.5 or 1.0 as noted on plans.
2. Install emitter types and quantities on the following schedule:

Ground cover plant: 1 single outlet emitter each or 1 single outlet emitter per square foot of planting area, whichever is less

Shrub: 2 single outlet emitters each

Tree: 4 single outlet emitters each or 1 multi-outlet emitter each (with 4 outlets open)

3. Use flexible plastic distribution tubing to direct water from emitter outlet to emission point. Use 1/8- or 1/4-inch diameter distribution tubing compatible with the emitters. Length of distribution tubing shall not exceed five feet. Secure distribution-tubing outlet with tubing stakes.

- D. Flush Cap Assembly: as presented in the installation details. Locate at the end of each drip irrigation lateral pipe. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.

2.8 CONTROL SYSTEM COMPONENTS:

A. Irrigation Controller Unit:

1. As presented in the drawings and installation details.
2. Primary surge protection arrestors: Per design details or as recommended by Rain Master.
3. Valve output surge protection arrestors: Rain Master Eagle controller specified with surge protection.
4. Electrical line conditioner: As recommended by the controller manufacturer.
5. Lightning protection: Provide 8-foot copper-clad grounding rod at controller location. Use American Wire Gauge No. 8 bare copper wire between the controller and grounding rod.
6. Lightning protection: Provide one 12" x 36" x 0.0625" ground plate, one 5/8"x10 foot copper clad UL listed grounding rod, 30 feet of #6 AWG bare copper grounding wire, and one CADWELD connector, and two 6-inch round valve boxes at each satellite controller group.
7. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
8. Switch/Outlet: Use 120 VAC, 15-amp combination switch/GFCI outlet.

B. Control Wire:

1. Use American Wire Gauge (AWG) No. 12 solid copper, Type UF or PE cable, UL approved for direct underground burial from the controller unit to each remote control valve.
2. Color: Use white for common ground wire. Use easily distinguished colors for other control wires (separate color for each controller). Spare control wires shall be of a color different from that of the active control wire. Wire color for each controller shall be continuous over its entire length.

3. Splices: Use wire connector with waterproof sealant (Spears DS-400).
4. Encase wiring not located near PVC irrigation pipe in PVC Schedule 40 electrical conduit.
5. Color: Wire color shall be continuous over its entire length. Install low voltage wires using the following color coding:
 - Controller "A" control wires: Red
 - Controller "B" control wire: Brown
 - Common wire: White
 - Spare control wires along wire routing from each controller: orange control wire color
 - Spare common wires along wire routing from each controller: White with blue stripe.
6. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored yellow, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

2.9 OTHER COMPONENTS:

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details, which are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3: EXECUTION

3.1 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Engineer/Landscape Architect/Owner's Representative prior to beginning work.
 2. Beginning work of this section implies acceptance of existing conditions.
- B. Utility Locates ("Call Before You Dig"):
 1. Arrange for and coordinate with local authorities the location of all underground utilities.
 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Engineer and Owner's Representative one week in advance of review. Modifications will be identified by the Engineer or Owner's Representative at this review.

3.2 LAYOUT OF WORK:

- A. Stake out the irrigation system. Items staked include: sprinklers, pipe, control valves, manual drains, controller, and isolation valves.
- B. Install all mainline pipe and mainline components inside of project property lines.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING:

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Minimum cover (distance from top of pipe or control wire to finish grade):
 - 1. 36-inches over 8" mainline pipe (maximum 48").
 - 2. 24-inches over mainline pipe sized 4 and 6-inch (and a maximum of 30-inches).
 - 3. 18-inches over mainline pipe sized 3-inch and smaller (and a maximum of 24-inches).
 - 4. Control wire: same burial depth as mainline, or no less than 16-inches.
 - 5. 12-inches over lateral pipe to sprinklers (and a maximum of 18-inches).
 - 6. All pipes that intersect must have a minimum of 6-inches clearance between the two pipes.
 - 7. Pipes shall not be allowed to be laid parallel in the same trench; a minimum separation of two feet shall be required of all parallel pipes.
 - 8. Control wires must be laid 2 to 4-inches off to one side of the mainline when laid in the same trench. Do not install wire under the mainline.
 - 9. **3-inch** minimum mulch cover over drip lateral pipe in planting beds downstream of drip system zone control valves.
- C. Maintain at least 15-feet clearance from the centerline of any tree this includes all equipment, storage of materials, and backfill material. Follow City of Loveland "Tree Protection Strategies" when work zone is within 25 feet of any tree.
- D. PVC pipes must be open trenched using a device specifically manufactured for trenching. Minimum burial depths equal minimum cover listed above.
- E. Backfill only after lines have been reviewed and tested.
- F. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, frozen materials, and stones larger than 1-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects, which may damage the pipe.
- G. Backfill unsleeved pipe in either of the following manners:
 - 1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
 - 2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to the density of surrounding soil.

- H. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Conduct one compaction test for each sleeved crossing less than 50 feet long. Conduct two compaction tests for each sleeved crossing greater than 50 feet long. Costs for such testing and any necessary retesting shall be borne by the Contractor. Use of water for compaction around sleeves, "puddling", will not be permitted.
- I. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades. Dispose of excess backfill off site. Dress backfilled areas to existing grade allowing for resod.
- J. Where utilities conflict with irrigation trenching and pipe work, contact the Engineer/Landscape Architect/Owner's Representative for trench depth adjustments.

3.4 SLEEVE AND BORING:

- A. Install sleeving at a depth, which permits the encased pipe or wiring to remain at the specified burial depth. Pipe shall be installed in a separate sleeve from wire sleeving.
- B. Extend sleeve ends six inches beyond the edge of the paved surface. Cover pipe ends and mark with stakes. Mark concrete with a chiseled "x" at sleeve end locations.
- C. Bore for sleeves under obstructions, which cannot be removed. Employ equipment and methods designed for horizontal boring.

3.5 ASSEMBLING PIPE AND FITTINGS:

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 - 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11 "
3"	100'	1'-11 "
4"	100'	1'-11 "
6"	150'	1'-4"
8"	200'	1'-0"
10"	250'	9"
12"	300'	8"

B. Mainline Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Rubber-Gasketed Pipe:
 - a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Ductile iron fittings shall not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.
3. PVC Solvent Weld Pipe:
 - a. Use Uni-Weld 7300 cleaner and Turf Tite solvent cement only. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
 - b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
 - c. Snake pipe from side to side within the trench.
4. Fittings: The use of cross type fittings is not permitted.

C. Lateral Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Solvent Weld Pipe:
 - a. Use Uni-Weld 7300 cleaner and Turf Tite solvent cement only. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
 - b. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
 - c. Snake pipe from side to side within the trench.
3. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Copper Pipe:
 - a. Buff surfaces to be joined to a bright finish. Coat with solder flux.
 - b. Solder so that a continuous bead shows around the joint circumference.
2. Galvanized Steel Pipe:
 - a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Use factory-made threads whenever possible. Field-cut threads will be permitted only where absolutely necessary. Cut threads on axis using clean, sharp dies.
 - c. Apply Teflon-type tape or pipe joint compound to the male threads only.
3. Ductile Iron Pipe:
 - a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
4. Insert a dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, stainless steel) are joined.
5. Low Density Polyethylene Hose: Install per manufacturer's recommendations.
6. Flanged connections: Install stainless steel studs and nuts and rubber gaskets per manufacturer's recommendations.
7. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Use only Teflon - type tape.
 - c. When connection is plastic-to-metal, the plastic component shall have male threads and the metal component shall have female threads.
8. Make metal-to-metal, threaded connections with nonhardening, nontoxic pipe sealant applied to the male threads only.

E. Thrust Blocks:

1. Use cast-in-place concrete bearing against undisturbed soil.
2. Size, orientation and placement shall be as shown on the installation details.
3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
4. Install rebar with mastic coating as shown on the installation details.

F. Joint Restraint Harness:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.

3.6 INSTALLATION OF MAINLINE COMPONENTS:

- A. Main System Shut Off Valve: Install where indicated on the drawings.
- B. Winterization Assembly: Install where indicated on the drawings.
- C. Backflow Prevention Assembly: Install where indicated on the drawings. Install assembly so that its elevation, orientation, access, and drainage conform to the manufacturer's recommendations and applicable health codes.
- D. Flow Sensor Assembly: Install where indicated on the drawings.

E. Isolation Gate Valve Assembly:

1. Install where indicated on the drawings.
2. Locate at least **12-inches** from and align with adjacent walls or edges of paved areas.

F. Quick Coupling Valve Assembly: Install where indicated on the drawings.

G. Mainline Tracer Wire: Installed on top of all mainline sections that do not have irrigation control wire in the same trench installed under this contract.

3.07 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:

1. Flush mainline before installation of RCV assembly.
2. Install where indicated on the drawings. Wire connectors (Spears DS-400) shall be used to connect control wires to remote control valve wires. Install pre-filled dry-splice connectors per the manufacturer's recommendations.
3. Install only one RCV to a valve box. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Allow at least 3-feet between valve boxes.
4. Adjust RCV to regulate the downstream operating pressure for proper head to head coverage and consistent spray pattern.
5. Attach ID tag with controller station number to control wiring.
6. Install all RCV 2-feet off the mainline to avoid having the RCV in the same trench as the mainline pipe.

B. Sprinkler Assembly:

1. Flush lateral pipe before installing sprinkler assembly.
2. Install per the installation details at locations shown on the drawings.
3. Locate rotary sprinklers 6-inches from adjacent walls, fences, or edges of paved areas.
4. Locate spray sprinklers 3-inches from adjacent walls, fences, or edges of paved areas.
5. Install sprinklers perpendicular to the finish grade.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

C. Bubbler Assembly:

1. Flush lateral pipe before installing bubbler assembly.
2. Install bubbler assembly per the installation details at locations shown on the drawings.
3. Adjust the output flow of each bubbler for best performance.

3.8 INSTALLATION OF DRIP IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Drip Laterals:

1. Flush mainline pipe before installing RCV assembly.

2. Locate as shown on the drawings. Wire connectors (Spears DS-400) shall be used to connect control wires to remote control valve wires. Dry-splice pre-filled connectors shall be installed as per the manufacturer's recommendations.
3. Install only one RCV to valve box. Locate at least **12-inches** from and align with nearby walls or edges of paved areas. Allow at least 3-feet between valve boxes.
4. Arrange grouped valve boxes in rectangular patterns maintaining at least 3-feet separation between valve boxes. Set RCV assembly discharge pressure to 30 PSI.
5. Install all RCV 2-feet off the mainline to avoid having the RCV in the same trench as the mainline pipe.

B. Zone Control Valve Assembly: Install at locations shown on the drawings.

C. Drip Emitter Assembly:

1. Locate as shown on the drawings and installation details.
2. Flush lateral pipe before installing emitter assembly.
3. Cut emitter outlet distribution tubing square.
4. Install all emitters in the planter/mulch area only. Do not install emitters in turf areas.
5. Use tools and techniques recommended by the manufacturer.
6. Make openings for barb-mounted emitters with the emitter manufacturer's hole-punching tool.

D. Flush Cap Assembly: Install at the end of each drip irrigation lateral pipe as shown on the installation details.

E. Pressure Adjustment Procedure:

1. Fully open all zone control valves and energize the RCV assembly.
2. Determine which emitter has the least outlet pressure; this is the critical emitter.
3. Identify zone control valve associated with the critical emitter; this is the critical zone control valve.
4. Set discharge pressure of RCV such that the critical vortex emitter has a pressure of 15 PSI + 2 PSI and/or the critical pressure compensating emitter has a pressure of 25 PSI + 5 PSI. Measure with pressure gauge attached to critical emitter.
5. Identify the critical emitter for remaining zone control valves.
6. Set each zone control valve such that its critical vortex emitter has a pressure of 15 PSI + 2 PSI and/or the critical pressure compensating emitter has a pressure of 25 PSI + 5 PSI.

3.9 INSTALLATION OF CONTROL SYSTEM COMPONENTS:

A. Irrigation Controller Unit:

1. The location of the controller unit as depicted on the drawings is approximate; the Engineer or Owner's Representative will determine the exact site location during sprinkler layout review.
2. Lightning protection: Drive 8-foot copper-clad grounding rod into the soil. If rock prevents driving, bury at least four feet deep. Use one rod for each controller. Connect controller to grounding rod with AWG No. 10 solid conductor copper wire. Secure wire to grounding rod with brass or bronze clamp. Locate the connection in a separate valve box.

3. Lightning protection: Provide on all remote control valve wiring as recommended by the manufacturer. Provide other components such as ground rod, grounding wire, etc., to manufacturer's recommendations.
4. Install primary surge protection arrestors on incoming power lines.
5. Install one valve output surge protection arrestor on each control wire and one for the common wire.
6. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
7. Install combination switch/GFCI outlet inside the controller pedestal or unit housing.
8. Connect control wires to the corresponding controller terminal.

B. Control Wire:

1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals.
2. Control wiring shall be open trenched using a device specifically manufactured for trenching pipe and wire installation. Minimum burial depth must equal minimum cover previously listed.
3. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90-degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box.
4. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
5. If a control wire must be spliced, make splice with wire connectors (Spears DS-400 pre-filled), installed per the manufacturer's instructions. Locate splice in a valve box, which contains an irrigation valve assembly, or in a separate 12-inch standard valve box.
 - a. Use same procedure for connection to valves as for in-line splices.
6. Unless noted on plans, install wire parallel with and 2"-4" (inches) off to one side of the PVC mainline pipe.
 - a. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill six inches above the wiring.

C. Central Control Unit:

1. The location of the central control unit as depicted or described on the drawings is approximate; the Engineer/Landscape Architect/Owner's Representative will determine the exact location upon commencement of contract.
2. Install and test central control components including microcomputer, computer peripherals, interface components, and communication hardware per manufacturer's recommendations and the Central Control Acceptance Test.

D. Instrumentation:

1. Install sensors per the installation details and manufacturer's recommendations. Install at locations shown on the drawings.
2. Install electrical connections between central control unit components and sensors per manufacturer's recommendations.

E. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 12-inch standard valve box. Coil 2 feet of wire in valve box.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install power wire in a separate trench at least 3-feet from the mainline.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.

F. Communication cable:

1. Route communication cable as directed on plans. Install with a minimum number of field splices.
2. All communication cable shall be laid in trenches and installed in conduit. The use of a vibratory plow is not permitted.
3. Carefully backfill around communication cable to avoid damage to wire insulation or wire connectors.
4. If a communication cable must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a housing afforded by other control system components or a separate 12-inch standard valve box. Coil 2 feet of communication cable in valve box.
5. Unless noted on plans, install wire 2"-4" (inch) off to one side of the mainline pipe.
6. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill six inches above the wiring.

3.10 INSTALLATION OF OTHER COMPONENTS:

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, supply to the Owner operating keys, servicing tools, spare parts, test equipment, and any other items indicated in the General Notes on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details, which are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.

- B. Record pipe and wiring network alterations. Record work, which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each backflow prevention device, each controller or control unit, each sleeve end, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
- C. Prior to construction completion, obtain from the Engineer/Landscape Architect/Owner's Representative a reproducible mylar copy of the drawings. Using technical drafting pen or CAD, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing".
- D. Turn over the "Record Drawings" to the Engineer. Completion of the Record Drawings will be a prerequisite for the Review at the completion of the irrigation system installation.

3.12 WINTERIZATION AND SPRING START-UP:

- A. Winterize the irrigation system in the fall of 2018 and start-up the irrigation system in the spring of 2019. Repair any damage caused in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the landscape maintenance personnel.

3.13 MAINTENANCE:

- A. Upon completion of construction and Review by the Engineer and Owner's Representative, maintain irrigation system for a duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.
- B. Following completion of the Contractor's maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after the landscape maintenance operation.

3.14 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to its original condition or as required by related specifications for this project.

END OF SECTION 328400

SECTION 329100 – LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Section includes maintaining the following items through final acceptance:

1. Irrigation System.
2. Seeded areas.
3. Trees and shrubs.
4. Mulch.

1.2 RELATED SECTIONS AND DOCUMENTS

- A. Section 328400: Planting Irrigation.
- B. Section 329219: Seeding.
- C. Section 329 00: Plants.
- D. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.3 SUBMITTALS

A. Notices - Submit the following written notices to the Owner:

1. A minimum of one (1) week prior to the start-up and/or winterization of the irrigation system.
2. A minimum of one (1) week prior to fertilization and/or the broad application of any chemicals or insecticides of any kind.

1.4 QUALITY ASSURANCE

A. Applicable Codes and Standards

1. Abide by the codes, specifications, and standards of all governmental and industry regulations including but not limited City, County, State of Colorado, and the standards of the American Association of Nurserymen (ANN), American Society for Testing and Materials (ASTM), National Plumbing Code (NPC), Colorado Technical Plumbing Code, Uniform Building Code (UBC), Sprinkler Irrigation Association (SIA), National Electric Code (NEC), American Sod Producers Association (ASPA), United States Department of Agriculture (USDA), and the Association of American Seed Control Officials (AASCO).
2. All labor shall be United States citizens or have current, valid work permits for work within the United States.
3. No chemicals or fertilizers shall be utilized on the work without a state licensed operator in attendance.

B. Equipment:

1. All equipment shall be well maintained and equipped with current safety features including audible reverse warning, trimming guards, etc.

1.5 MAINTENANCE PERIOD

- A. Required maintenance for all items shall extend until date of final acceptance of the entire project. This period will last through a minimum of two lawn cuttings for sodded areas.
- B. After acceptance of the entire project, the Owner will assume responsibility for maintenance. The warranty will begin at date of acceptance of all landscape construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 IRRIGATION SYSTEM

A. Start-Up:

1. The Contractor shall be responsible for the start-up of the automatic irrigation system. Unless modified by extreme weather conditions, the system shall be activated not before April 1 and not later than April 30.
2. To activate system, pressurize and then run each zone a minimum of 15 minutes. Each zone shall be observed for leaks, pressure defects, adequate coverage, and other conditions which shall impact the effective operations of the system. Any leaks or defects shall be corrected immediately.

B. Controller Settings:

1. Properly program the irrigation controller to insure adequate but not excessive watering throughout the year.
2. Following acceptance of the entire project by Owner, the Owner will assume responsibility for controller settings. Contractor may monitor controller settings during the warranty period, but shall not alter the settings without first notifying the Owner in writing.

C. Testing System:

1. At a minimum of once each month between May and October, manually operate each and every irrigation zone to insure continued and adequate coverage, pressure, and the absence of leaks. All system leaks or defects shall be corrected immediately.

D. Winterization:

1. The Contractor shall be responsible for the first winterization of the automatic irrigation system. Unless modified by extremely mild weather conditions, the system may be shutdown and winterized by November 25. The requirement shall remain in effect even if the Owner has accepted the project.
2. In the week immediately prior to closing of the system, all landscape areas shall receive a minimum of 1.5" of watering (either through natural conditions or through operation of the system).
3. Winterize the system by closing the main pressure valve opening, all stop and waste valves, removing water from the lines, de-energizing the controller, and all other actions deemed prudent. Remove water from drip lines by opening flushing points and blowing out all water.

3.2 TURF SEEDED AREAS

A. Fertilization:

1. Fertilize all sodded areas four (4) weeks minimum after installation.
2. Fertilizer shall be a Urea based only mixture with the following chemical composition: 20-15-15. All applications shall be at a rate of 5 lbs. nitrogen per 1000 square feet.
3. These feedings are specifically in addition to those required by the installation specification.
4. All fertilizer applications shall occur using a commercial spreader on a calm, dry morning. The sod should be moist. Never fill the spreader over the lawn areas or when "on". Sweep all concrete and asphalt areas that may have been pelleted with fertilizer.
5. In addition to the lawn fertilization, one (1) application of elemental iron shall be made at a rate of 0.5 lbs. per 1000 square feet.

B. Weeding and Insect Toxins: Contractor is responsible for weed control until acceptance of the entire project. No application of weed killer, insecticides, or antifungal chemicals are specified. Apply these elements as necessary to maintain healthy, weed free sod throughout the year. Apply as per manufacturer's recommendations whenever necessary to protect the sod condition.

1. If site is open to the public, post notice of the applications.
2. Take all precautions when applying weed killers, insecticides or antifungal remedies, including gloves, masks, goggles, etc., and shall not apply on windy or rainy days.
3. This section includes insects, molds, fungus, broadleaf, and viney weeds and specifically includes grasshoppers.

F. Cuttings: Cut sod with a reel or rotary type mower. Keep grass an average of 2 inches in height and cut whenever the clippings will measure approximately 0.5 inch or 25 percent of the grass plant. Never cut off more than 33 percent of the plant height. Between May 1 and September 15, cut grass a minimum of once every two weeks.

1. If mowing creates visible accumulations of clippings, clippings must be removed. Remove all clippings immediately. Cross slope all mowing. All areas around walks, buildings, curbs, walls, rocks, plants, lights, or other structures must be trimmed by hand or mechanical trimmer each time the grass is cut. All cuttings must be done diagonal to the way the sod was laid. Clean cuttings from walks, plazas, drives, etc.

3.3 SEEDED AREAS

- A. General: The maintenance period shall begin immediately after each area is seeded and continue until final acceptance of entire project. During this time, the Contractor shall be responsible for watering, mowing, spraying, weeding and all related work as necessary to ensure that seeded areas are in a vigorous growing condition. Provide all supervision, labor, material, and equipment to maintain seeded areas.
- B. Materials: Conform to specifications or to be acceptable to by Owner.
- C. Watering: Water irrigated areas at regular schedule to be accepted by Owner until stand of grass is established. Water in repeated short time periods. After grass is established, water irrigated grass at a regular schedule to be accepted by Owner. Native and dryland grasses are not required to be watered. Water shall be free of substances harmful to plant growth. Be responsible for furnishing water from underground sprinkler system, quick couplers or other source.
- D. Reseeding: Per Section 329219.
- E. Fertilization: Per Section 329113.
- F. Weed Control: Native Seed/Dryland Grasses: As required, using selective herbicides approved by Owner.
- G. Insect and Disease Control: As required, apply insecticide and fungicide approved by Owner.

3.4 TREE AND SHRUB CARE

- A. Maintenance crew shall inspect the plant material on a monthly basis. A written report of problems shall occur after each inspection.
- B. Immediately report and dead plant or dead part of the plans. Do not prune or remove branches or suckers.
- C. Replace at not cost to the Owner any plant material which dies due to failure to comply with this specification or negligence or insect damage. This guarantee applies to trees which are damaged due to maintenance crew's mowing operations.
- D. Remove tree stakes, tree guys, guy wire, and tree wrap prior to completion of one-year warranty period.

3.5 WINTER WATERING

- A. Contractor's maintenance crew to water all plant materials once each month during December, January, February, and March as needed to adequately sustain plant material through the winter, unless the Owner has accepted the project. Trees need to be watered when temperatures are above freezing at 10 gallons per caliper inch.
- B. This watering shall occur from sillcocks of the building. If sillcocks are frozen or cannot be activated Contractor shall utilize a water truck. Raw water system will be unavailable during winter months.

END OF SECTION 329100

SECTION 329113 – FINE GRADING AND SOIL PREPARATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Ripping.
- B. Fertilizer.
- C. Soil amendments.
- D. Fine grading.

1.2 RELATED SECTIONS AND DOCUMENTS

- A. Section 310000: Earthwork.
- B. Section 328400: Planting Irrigation.
- C. Section 329100: Landscape Maintenance.
- D. Section 329219: Seeding.
- E. Section 329300: Plants.
- F. Appendix B: Soils Test Report – CSU
- G. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.3 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Certificates: State, federal and other inspection certificates shall accompany invoice for all materials showing source or origin. Submit to Owner's Representative prior to acceptance of materials.
 - 2. Soil Amendment Test Report: Submit soil conditioner test analysis to Owner's Representative 3 weeks prior to delivery to site in accordance with Division 01 requirements.

1.4 QUALITY ASSURANCE

- A. The work of this section shall be performed by an experienced landscape Installer having not less than 5 years successful experience in landscape projects of similar size and scope as this project. Include work of Sections 329219 and 329300 for undivided responsibility.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, bearing name and warranty of producer.
- B. Notify Owner's Representative of delivery schedule in advance so material can be inspected upon arrival at project site. Immediately remove unacceptable material from project site.

1.6 PROJECT/SITE CONDITION

- A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.
- B. Vehicular accessibility on site shall be as directed by owner's representative. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this section to original condition at no additional cost to Owner.
- C. Perform soil preparation just prior to planting operations and in accordance with final planting schedule. Coordinate with irrigation system installation to avoid damage to work of one by the other.
- D. Utilities: Determine location of underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required.

PART 2 - PRODUCTS

2.1 SOIL AMENDMENTS

- A. Composted Amendment: Class 1 Compost meeting the following:

- | | |
|-----------------------------|----------------------------------------------------------------|
| 1. Organic Matter Content | > 20% |
| 2. Soluble Salts | < 5 mmhos/cm |
| 3. pH units | < 6-8.4 |
| 4. Carbon to Nitrogen ratio | < 12:1 |
| 5. Particle size | 99.8% < 9.5mm. No silt or clay. No particles over ½" diameter. |

Apply at a rate of 4 cubic yards per 1,000 square feet, tilled to a minimum of 9" depth, for sod and seeded areas.

- B. Compost Certification Specifications:

- 1. Composted soil amendments must be produced at a facility permitted and regulated under the State of Colorado Department of Public Health and Environment and/or the county in which the facility operates for the production of compost and soil amendments.

2. The product must be certified to have been produced in a manner that meets the US EPA 40CFR 503.13 minimum standards for pathogen destruction under a controlled, monitored, and documented process.
3. The supplier must certify that no supplemental nitrogen or other chemicals have been added to the compost to alter or enhance the results of the laboratory analysis, unless specifically requested by the design architect.
4. The contractor must supply a letter of certification from the manufacturer which confirms that the product being supplied has met the referenced requirements and that supporting documentation exists and is available for inspection (if requested).

2.2 TOPSOIL

- A. Clean topsoil will be stockpiled or imported for sodded areas and spread to 6" minimum depth under other Sections of this Division.

2.3 FERTILIZER

- A. Commercial Fertilizer:

1. Seeded Lawns:
 - a. Commercial fertilizer having an available nutrient analysis of 20-10-5, 35% SCU shall be applied to the seed at a rate of 4 pounds per 1,000 square feet.

2.4 HERBICIDE

- A. Roundup by Monsanto: Apply according to manufacturer's instructions using certified applicators.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Verify that existing site conditions are as specified and indicated before beginning work under this section.
 1. Grades: Inspect to verify rough grading is within + 0.1 foot of grades indicated and specified.
 2. The finish grade shall conform to site specifications and ensure proper drainage at all locations. Level all areas so as to be even with the top edge of walks, edging, valve boxes, irrigation heads and other hardscapes set at grade. All areas requiring fill shall use screened topsoil free of stone or other debris. All turf areas shall be a maximum of a one-foot drop per four feet unless otherwise specified for mower safety.
 2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete water, mortar, limewater or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Owner's Representative.
- B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Owner's Representative.

- C. Acceptance: Beginning of installation means acceptance of existing conditions by installer.

3.2 PREPARATION

A. Protection:

1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
2. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this section.
3. Pay for repairs made by contractor(s) designated by Owner.

- B. Weed Control: Remove perennial weeds by applying herbicide 1 week before final grading and as needed. Remove annual weeds by tilling. Water prepared soil for two weeks if possible and apply herbicide to exposed weeds.

- C. Surface Grade: Remove weeds, debris and rocks larger than 1". Dispose of accumulated debris at direction of Owner's Representative.

- D. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water to run off the grounds as is intended by the grades.

- E. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site throughout duration of work.

3.3 INSTALLATION

A. Soil Amendment

1. Limit preparation to areas which will be planted promptly after preparation.
2. Before tilling, clean topsoil of stones, clay lumps, and other extraneous materials 1 ½" in size and remove from site during rough grading. Leave seeds and plants for native seed areas. Use soil devoid of seeds and plants in sodded and seeded lawn areas.
3. Prepare all areas to be seeded or sodded by ripping the surface to a minimum depth of four (4) inches. Three weeks prior to ripping, these areas shall be sprayed with a non-selective herbicide to kill all weeds and grasses. This herbicide shall be labeled safe for new plantings after that three-week period.
4. Sodded Lawns: Spread soil amendments and phosphate at the rate specified after topsoil (if specified) is spread. Till in thoroughly to a minimum depth of 6"-9", and grade to meet lines, grades and elevations shown, allowing for natural settlement.
5. Native Seed and Seeded Lawns: Spread soil amendments and fertilizer at the rate specified after topsoil is spread. Till in thoroughly to a minimum depth of 6", and grade to meet lines, grades and elevations shown, allowing for natural settlement.

B. Fine Grading in all Landscape Areas:

1. Do fine grading for areas immediately prior to planting.

2. For ground surface areas surrounding buildings to be landscaped, maintain required positive drainage away from buildings.
3. Establish finish grades to within 0.05 foot of grades indicated. The intent of this spec is to prevent 'bird baths' or ponding.
4. Finish grade to be below edge of pavement prior to sodding, seeding or planting.
 - a. Shrub Beds: Allow 4" for mulch.
 - b. Seeded Areas: Allow 1" for seed.
5. Noxious weeds or parts thereof shall not be present in the surface grade prior to landscaping.
6. Compaction of Surface Grade Prior to Landscape Installation: Firm, but not hard (80% standard Proctor density within 2% optimum moisture).
7. Prior to acceptance of grades, rake to smooth, even surface free of debris, clods, rocks, and vegetable matter greater than 1". Native seed areas should not be raked smooth but left in a uniform condition after tilling. Rough raking may occur parallel to the contour only.
8. Seeded Lawns: Apply fertilizer, at the rate specified, after fine grading and prior to seeding.
9. Fertilizer shall not be applied when dirt/sod is damp or wet.
10. Fertilizer shall be spread with a mechanical spreader to ensure a uniform rate of application.
11. After fertilizing, thoroughly soak work area.
12. Restore planting areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
13. All trenches or areas of excavation must be settled or compacted prior to the start of any finish grade work. Any settling of said areas would be the sole responsibility of the Contractor for the period of one year.

3.4 NOTIFICATION AND INSPECTION

- A. Inspection: Provide notice to Owner's Representative requesting inspection at least 7 days prior to anticipated date of completion.
- B. Deficiencies: Owner's Representative will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Owner's Representative for final inspection.

3.5 CLEANING

- A. General: Remove debris and excess materials from site. Clean out drainage inlet structures. Clean paved and finished surfaces soiled as a result of work under this section, in accordance with direction given by Owner's Representative.

3.6 PROTECTION

- A. General: Provide and install barriers as required and as directed by Owner's Representative to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by Owner. Contractor is not responsible for malicious destruction caused by others.

3.7 WARRANTY

- A. Contractor to warrant that puddling, sinking or caving directly due to earthwork operations does not occur within the warranty period.

END OF SECTION 329113

SECTION 329219 – SEEDING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Seeding and fertilizing.
- B. Maintaining seeded areas until acceptance.

1.2 RELATED SECTIONS AND DOCUMENTS

- A. Section 328400: Plant Irrigation.
- B. Section 329113: Fine Grading and Soil Preparation.
- C. Section 329300: Plants.
- D. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.3 REFERENCES

- A. Reference Standards: Comply with U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and be equal in quality to standards for Certified Seed.

1.4 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Certificates: State, federal or other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Owner's Representative prior to acceptance of the material.
- B. Contract Closeout Submittals:
 - 1. Operating and Maintenance Data: At completion of work, submit 3 copies in accordance with Section 017000. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continuance and proper maintenance through full growing season and dormant period.
 - 2. Contractor to provide all delivery load tickets for seed, fertilizer, and mulch prior to acceptance of work under this section.
 - 3. Warranty for Seed Areas: At completion of work, furnish written warranty to Owner based upon requirements as specified. See Section 3.08.

1.5 QUALITY ASSURANCE

- A. Planting and seeding shall be done with the approval of the Owner's Representative only when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting. Special conditions may exist that warrant a variance in the specified planting dates or conditions. A written request shall be submitted to or originate from the Owner's Representative stating the special conditions and proposed variance.
- B. Seeding shall be done within the following dates:
 - 1. Native/dryland seed - From April 15 to June 15 for spring seeding; and from August 15 to September 20 for fall seeding.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Seed: Deliver seed in sealed standard containers stating correct name and composition on the outside of the container. Seed damaged in transit or storage will not be accepted. Retain tickets and tags from seed bags and submit to Owner's Representative.
- B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, and bearing name and warranty of producer. Retain tickets for submittal to Owner's Representative.
- C. Material may be inspected upon arrival at project site.
- D. Immediately remove the unacceptable material from job site.

1.7 EXISTING CONDITIONS

- A. Beginning work means acceptance of existing conditions.

PART 2 - PRODUCTS

2.1 SEED

- A. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, the percent of weed seed content, and the guaranteed percentage of purity and germination. All brands furnished shall be free from such noxious seeds such as Russian or Canadian Thistle, European Bindweed, Johnson Grass, and Leafy Spurge. The Contractor shall furnish to the Owner's Representative a signed statement certifying that the seed furnished is from a lot that has been tested within six months prior to the date of delivery. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed shall be certified to be a hardy strain of the following seeds at the indicated rates of pure live seed per acre.
- B. Computations for quantity of seed required are based on the percent of purity and percent of germination: Pounds of seed x purity x germination = pounds of pure live seed (PLS).

- C. Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.
- D. Use seed only specified and approved by the City. No other seeds shall be accepted. All seed shall be furnished by an established dealer or certified seed grower.
- E. Seed shall be fresh, clean, new crop seed, composed of the varieties specified and be of certified quality.

F. Irrigated Turfgrass Mixture:

Kentucky Bluegrass	Award, Certified Quality	27%
Kentucky Bluegrass	Midnight, Certified Quality	27%
Kentucky Bluegrass	Touchdown, Certified Quality	26%
Perennial Ryegrass	Manhattan 3 Certified Blend	20%

Application rate of 6 lbs/1000 sf.

G. Native Seed Mixture:

<u>Common Name/Scientific Name</u>	<u>Variety</u>	<u>Number Seeds/lb</u>	<u>Percent of Mix</u>	<u>Pounds PLS/acre</u>
Blue Grama/Bouteloua gracilis	Lovington	712,000	8	0.3
Side Oats Grama/Bouteloua curtipendula	Vaughn, El Reno	143,000	10	2
Buffalo grass/Buchloe dactyloides		42,000	10	6.2
Western Wheatgrass/Agropyron smithii	Barton	120,000	11	2.5
Bluebunch Wheatgrass/ Agropyron spicatum	Secar	150,000	10	1.8
Needle and Thread/Stipa comata		115,000	3	1
Indian Rice Grass/Oryzopsis hymenoides	Paloma	141,000	8	1.5
Big Bluestem/Andropogon gerardii	Kaw	191,000	5	0.7
Little Bluestem/Andropogon scoparius	Pastura	379,000	5	0.3
Fringed Sage/Artemisia frigida		4,500,000	6	0.1
Rubber Rabbitbrush/ Chrysothamnus nauseosus		693,000	6	0.1
Lewis Flax/Linum lewisii		295,000	4	0.4
Yarrow/Achillea millefolium		8,275,000	4	0.1
Purple Prairie Clover/ Petalostemum purpureum		295,000	5	0.5
Upright Prairie Coneflower/ Ratibida columnifera		900,000	5	0.2
TOTALS			100	17.7
Grass Percentage			70	
Shrub/Forb Percentage			30	

2.2 ACCESSORIES

- A. Mulching Material: No mulching.

- B. Netting: Soil Saver jute netting or accepted substitute.
- C. Staples: No 11-gauge steel wire formed into a "U" shape 6" long.

PART 3 - EXECUTION

3.1 PREPARATION OF FINAL GRADE

- A. Protect existing underground improvements from damage.
- B. Prepare soil as specified in Section 329113.
- C. Moisten prepared seed areas in irrigated areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting seed. Do not create a muddy soil condition. Seeding operations shall occur only when weather and soil conditions permit and in accordance with locally accepted practices.
- D. Restore seed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.2 FERTILIZING

- A. Apply fertilizer as specified in Section 329113.
- B. Do not apply grass seed or fertilizer in same machine at same time.

3.3 SEEDING

- A. Drill Seeding: All native areas are to be drill seeded, except for small areas inaccessible to seed drilling equipment. Such areas to be broadcast seeded.
 - 1. Seeding shall be done with a drill equipped with a satisfactory seeding mechanism, agitator, double dish furrow openers and packer wheels, and a separate box for small seeded grasses (Brillion mechanical seeder or equal). Seed shall be uniformly sown (one-half in one direction and the other half at right angles to the first sowing. The direction of the final sowing shall always be at a right angle to the slope or running in the direction of the contour). Seeds shall be sown at a depth of approximately one-half inch (1/4"), with bands no more than three (3") apart.

Do not sow immediately following rain, or when ground is too dry, or during windy periods.
 - 2. Rolling: Roll seeded area with roller not exceeding 112 lbs.
- B. Do not sow immediately following rain, or when ground is too dry, or during windy periods.
- C. Apply water with fine spray immediately after each area has been sown.

D. Broadcast Seeding:

1. Small areas inaccessible to seed drilling equipment to be seeded by broadcast method using a drop or whirly-bird type spreader. Seed shall be broadcast at double the application rates specified above. Apply seed in two equal applications, in perpendicular directions, to assure uniformity.
2. Lightly rake seeded areas after seed is broadcast. Final raking shall be in a direction perpendicular to the slope of the land.
3. Seeding will not be permitted when wind velocity is such as to prevent uniform seed distribution. No application shall be undertaken during inclement or the forecast of inclement weather. No application shall take place in the presence of free surface water or when the ground is frozen or otherwise untillable.

3.4 MULCHING

- A. No straw products are allowed.
- B. Mulch Application: Mulching of seed areas to be accomplished using an approved hydromulcher to apply wood cellulose fiber at rate of 2,000 pounds per acre. Hydromulch slurry shall be sprayed uniformly over the seeded areas.
- C. Mulch Tackifier shall be applied over the mulched areas at the rate of 200 pounds per acre.
- D. All areas shall be seeded and hydromulched within thirty (30) days from the date the erosion control permit is issued. Additional time may be granted with written approval from the Erosion Control Inspector.
- D. Mulching shall not be done in the presence of free surface water resulting from rains, melting snow, or other causes.
- E. All work and traffic patterns shall be done as to minimize compaction. Repeated use of the same traffic pattern causing compaction will need to be ripped and final graded again prior to seeding and mulching.
- F. Areas not properly mulched, or damaged due to the Contractor's negligence, shall be repaired and remulched in an acceptable manner at the Contractor's expense. Mulch removed by wind prior to acceptance shall be re-established by the contractor at his own expense.
- F. The seeded area shall be mulched within 24 hours after seeding. Areas not mulched within 24 hours after seeding must be re-seeded with the specified seed mix at the Contractor's expense.
- G. Contractor is to remove all hydromulch from plant materials, fences, paved areas, and buildings as directed by owner.

3.5 EROSION CONTROL

- A. Area: Apply crimped straw and hydromulch binder to any area which is vulnerable to soil erosion such as swales or steep slopes (over 3:1).

1. If Contractor fails to control such areas and soil erosion subsequently occurs, Contractor shall re-establish finish grade, soil preparation, seed bed, and apply erosion control at his own expense.

B. Jute Netting:

1. Roll out in direction of flow after seeding and mulching.
 - a. Apply material loosely and smoothly on soil surface without stretching.
 - b. Avoid walking directly on seed-bed either before or after jute is applied.
 - c. Bury up-channel end of each piece of jute netting in narrow trench 6" deep. After jute is buried, tamp trench firmly closed.
2. In cases where one roll of netting ends and second roll is needed, overlap up-channel piece over second roll by at least 18". Where two or more widths of netting are applied side by side, make overlap of at least 4".
3. Outside Edges of Netting: Spread loose topsoil over edges to allow for smooth entry of water.

C. Stapling: Staple overlaps which run parallel to direction of flow in channel bottoms on 2 ft. intervals. Staple outside edges, centers and overlaps on banks on 2 ft. intervals.

1. Each Width of Cloth: Install row of staples down center as well as along each side.
2. Staple check slots and junctions of new rolls across channel on 6" intervals.
3. On soft or sandy soil or in windy areas. Apply staples in alternative slanting position and space at 14" to 18" intervals.
4. For extra hard soil or shale areas, use sharp hardened steel 3" fence type staples. Do not use 3" staples on normal turf.

3.6 CLEAN UP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition. Any damage to other work done by landscape crew is to be reported and repaired immediately.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.7 ACCEPTANCE

- A. Any seed areas showing signs of poor germination and growth within three weeks of planting shall be reseeded by the Contractor and thereafter for a period of one year.
- B. Seeded areas will be accepted upon the establishment of an even, uniform grass cover. This does not imply that a full sod is necessary. The result is based on a visual evaluation indicating a uniform ground cover of about 90% germination with no bare spots larger than 6" diameter. Contractor to maintain seeded areas until acceptance, and through maintenance period.

3.8 WARRANTY

- A. Warranty for Irrigated Turf and Dryland Seeded Areas: Warrant areas in seed to be in a healthy, vigorous growing condition, and for consistency and completion of coverage at the end of

warranty period During the warranty period, re-seed any spots where seed has not germinated within the total seeding area. Continue this procedure until a successful stand of grass is growing and accepted by the Owner's Representative. Warranty period will be extended if necessary until a uniform 90% germination rate has been accomplished.

END OF SECTION 329219

SECTION 329300 – PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.
2. Tree-watering devices.
3. Landscape edgings.
4. Temporary support.
5. Mulch.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- C. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- D. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Plant Selection: Trees shall be selected (tagged) by Landscape Architect at the nursery.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples of each type of mulch.

1.5 INFORMATIONAL SUBMITTALS

- A. Product certificates: Submit certificates of inspection as required by governmental authorities. Submit manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.
- B. Planting Schedule: Submit proposed planting schedule in writing, indicating dates for each type of landscape work during normal seasons for such work in area of site. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- C. Variances from Specification: All variances must be approved in writing by the City of Loveland.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.7 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Owner's Representative, together with proposal for use of equivalent material.
- D. Hardiness: Plants grown in hardiness zones 1, 2, 3, and 4 only will be accepted. Hardiness zones are defined in U.S. Dept. of Agriculture publications. Grower's certificates may be required when doubt exists as to the origin of plant material.
- E. Plant Source: All plants shall be nursery grown or gathered native plants approved by Owner's Representative. Imported plants shall have been growing in a nursery for a minimum of one growing season. Trees and shrubs shall have been root-pruned during their growing period in the nursery in accordance with standard nursery practice and shall meet the requirements of the Colorado Nursery Act, or the American Association of Nurseryman's Standards for Nursery Stock, whichever is more stringent.
- F. Each tree and shrub shall be labeled with securely attached waterproof tag bearing legible designation of botanical and common name.
- G. Inspection: The Owner's Representative will approve all stock before it is installed. The inspector shall be given a minimum of 48-hours notice to inspect plant material. Any plant

material planted without an inspection is subject to immediate removal/replacement at the discretion of the inspector and at the expense of the contractor. Inspector may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Owner's Representative retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries, and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

Grounds for rejection of plant material may include, but are not restricted to the following conditions:

- obvious disease infection or insect infestation
- broken, cracked root balls
- dry or instable root balls
- material with evidence of girdling or circling roots
- lack of roots in the upper 6 inches of the root ball, or soil mounded over 6" of the trunk
- damage to the plant material including scarring, past canker damage, girdling or indentation in bark caused by twine used to secure the basket, past borer damage, graft incompatibility
- wilting of the leaves beyond recovery
- poor structure, not correctible by pruning within 2 years
- branches at narrow angles to the main stem, or included bark in the branch-trunk connections
- unspecified i.e., incorrect species or cultivar

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- B. Handle planting stock by root ball.
- C. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots and plant moist. If plants are stored on site prior to planting for an extended time, trees must be healed in.

- D. Move plant materials with solid balls wrapped in burlap, or in approved containers.
- E. Reject plants when ball of earth surrounding roots has been cracked or broken prior to or during process of planting.
- F. Reject plants when burlap, stakes, and ropes required in connection with transplanting have been displaced prior to acceptance.

1.9 JOB CONDITIONS

- A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
- B. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner's representative before planting.
- D. Planting Time: Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

1.10 WARRANTY

- A. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - 2. Warranty Periods: From date of Final Acceptance.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock,

densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- C. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single-stem trees, except where special forms are shown or listed.
 - 1. Provide balled and burlapped (B&B) deciduous trees.
 - 2. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.
 - 3. Field dug deciduous trees will be accepted based on prior approval by Owner's representative.
- D. Deciduous Shrubs: Provide shrubs of the container size shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required. All shrubs will be container grown in the sizes indicated on the plans.
- E. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum height for upright trees, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.
 - 1. Provide balled and burlapped (B&B) evergreens.
 - 2. Container grown evergreens will be acceptable subject to specified limitations for container grown stock.
 - 3. Field dug evergreen trees will be accepted based on prior approval by Owner's representative.

2.2 PLANTING PIT BACKFILL

- A. Soil backfill for planting pits shall consist of the following mixture:
 - 1. Planting backfill for trees shall consist of soil at the planting site well tilled.

2.3 FERTILIZERS

- A. Trees shall not be fertilized unless a soil test indicates specific deficiency.

2.4 MULCHES

- A. Mulching: All single trees and planting beds shall be mulched with 4" depth clean shredded cedar mulch. Mulch shall form a circle, 2'-6" diameter, around single trees.

2.5 WEED-CONTROL BARRIERS

- A. Soil Stabilization/Weed Barrier Fabrics: No weed control barrier shall be installed over planting site of trees.

2.6 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.7 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: See Section 328400 – Planting Irrigation.

2.8 ACCESSORIES

- A. Wrapping: Tree wrap tape not less than 4" wide, designed to prevent winter injury.
- B. Stakes and Guys: As indicated on drawing details.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: Place and mix planting soil in-place over exposed.
- C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Owner's Representative's acceptance before start of planting work. Make minor adjustments that may be requested.
- E. Preparation of Soil Backfill for Planting Pits:
 - 1. Before mixing, clean pit excavations of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
 - 2. Mix specified soil amendments with soil at rates specified.
- F. Sequencing and Scheduling:

1. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations. Plant or install materials during normal planting seasons for each type of plant material required.
2. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

3.2 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular saucer shaped planting pits.

1. Excavate planting pits with sloping sides. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately twenty-four inches wider than the ball and three inches shallower than the ball height. Planting material shall be placed at the center of the well. The finished saucer shall follow the outer line of excavation and extend six inches high and eight inches wide. All wire, burlap, containers or other foreign materials must be fully removed prior to backfilling the well.
3. Planting of trees and shrubs shall be a separate operation from irrigation installation **and turf establishment**, and shall occur subsequent to these segments of the project.
4. The soil shall be ripped to a minimum depth of twelve inches throughout those areas planted to trees and shrubs.
5. All clods, debris, rocks and other items two inches or more in diameter shall be removed from the job site.
6. All soil contaminated by spilled petrochemicals or other materials, or concrete truck washing shall be removed from the jobsite per applicable "Federal, State and local laws and regulations.
7. Vehicles shall not be driven or parked on those areas to receive trees and shrubs; if trucks are needed to deliver plant material to a location close to the planting sites, such activity will take place when soil moisture is low enough that compaction/rutting will not occur.
8. It is the responsibility of the contractor to assure that all utilities, including those that are property of the owner, are located and marked, and that such markings shall be kept highly visible.
9. For container grown stock, excavate as specified for balled and burlapped stock.
10. Dispose of unacceptable subsoil removed from landscaped excavations. Do not mix with planting soil or use as backfill.
11. Use well tilled soil on site for backfill for setting and filling all plants.
12. Where rubble fill is encountered, notify Landscape Architect and prepare planting pits properly by removal of rubble or other acceptable methods. When conditions encountered are severe and extensive (as determined by Architect) proceed with additional work at the direction of the Architect.
13. Drainage: If subsoil conditions indicate the retention of water in planting areas, as shown by seepage or other evidence indicating presence of underground water, notify the Landscape Architect before backfilling.

B. Backfill Soil:

1. Four parts native soil from pit excavation.
2. One part soil amendment per Section 329113.

3. Materials to be thoroughly blended.

3.3 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 1. Backfill: Planting soil. For trees, use excavated soil well tilled for backfill.
 2. Balled and Burlapped Stock: Cut bottom of basket and burlap. Place tree, add some backfill. Carefully cut and remove burlap, rope, and wire baskets from root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Balled and Potted and Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
 4. Backfill around root ball in layers, irrigating to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 5. Continue backfilling process. Water again after placing final layer of soil.
 6. For container grown stock, remove plant from container, split root ball 50% up from bottom, spread roots over mounded backfill under roots as required to eliminate voids and prevent settling. Complete backfilling on top of pit.
 7. Mound top of backfill in irrigated areas. Provide bowl for water retention in dryland areas.
 8. Wrap tree trunks of 1" caliper and larger. Start at ground and cover trunk to height of first branches and securely attach with tape. Inspect tree trunks for injury, improper pruning, and insect infestation and report before wrapping.
 9. Guy and stake trees immediately after planting, as indicated.
- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE, SHRUB, AND VINE PRUNING

- A. Do not prune newly planted trees, except for broken limbs. Prune broken material according to standard professional horticultural and arboricultural practices.
- B. Do not apply pruning paint to wounds.

3.5 GROUND COVER PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

- A. Do not provide weed barrier fabric at planting beds or tree plantings.
- B. Mulching: All single trees and planting beds shall be mulched with 4" depth clean shredded cedar. Mulch shall form a circle, 2'-6" diameter around single trees.

3.7 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. See Section 328400 –Irrigation.

3.8 PLANT MAINTENANCE

- A. Maintain plantings by cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Report all damaged plantings.
- F. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.9 MAINTENANCE SERVICE

- A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period for Plant Material: 12 months from date of Substantial Completion.

END OF SECTION 329300

SECTION 331000 – WATER UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Buried pipe, fittings, hydrants, valves, appurtenances, and associated accessories for water distribution
- B. Disinfection of potable water piping

1.2 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. A36 – Standard Specification for Carbon Structural Steel
 - 2. A48 – Standard Specification for Gray Iron Castings
 - 3. A53 – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
 - 4. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 5. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - 6. A242 – Standard Specification for High-Strength Low-Allow Structural Steel
 - 7. A276 – Standard Specification for Stainless Steel Bars and Shapes
 - 8. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
 - 9. A449 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
 - 10. A536 – Standard Specification for Ductile Iron Castings
 - 11. A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
 - 12. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 13. A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 14. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings
 - 15. B88 – Standard Specification for Seamless Copper Water Tube
 - 16. B96 – Standard Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels
 - 17. B763 – Standard Specification for Copper Alloy Sand Castings for Valve Applications
 - 18. B843 – Magnesium Alloy Anodes for Cathodic Protection
 - 19. C33 – Standard Specification for Concrete Aggregates
 - 20. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 21. C150 – Standard Specification for Portland Cement

22. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
23. C1227 – Standard Specification for Precast Concrete Septic Tanks
24. D429 – Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
25. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kn-m/m³))
26. D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
27. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
28. D1330 – Standard Specification for Rubber Sheet Gaskets
29. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
30. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
31. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
32. D2000 – Standard Classification System for Rubber Products in Automotive Applications
33. D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
34. D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
35. D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
36. D2454 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
37. D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing
38. D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
39. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
40. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
41. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
42. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
43. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
44. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
45. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
46. D3950 – Standard Specification for Strapping, Nonmetallic (and Joining Methods)
47. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
48. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
49. D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
50. E8 – Standard Test Methods for Tension Testing of Metallic Materials
51. F412 – Standard Terminology Relating to Plastic Piping Systems

52. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
53. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
54. G97 – Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications

B. American Water Works Association (AWWA)

1. B300 – Standard for Hypochlorites
2. B301 – Standard for Liquid Chlorine
3. B302 – Standard for Ammonium Sulfate
4. B303 – Standard for Sodium Chlorite
5. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
6. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
7. C110 – Standard for Ductile-Iron and Gray-Iron Fittings
8. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
9. C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
10. C116 – Standard for Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
11. C150 – Standard for Thickness Design of Ductile-Iron Pipe
12. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast
13. C153 – Standard for Ductile-Iron Compact Fittings
14. C200 – Standard for Steel Water Pipe 6 In. (150 mm) and Larger
15. C203 – Standard for Coal-Tar Protective Coatings & Linings for Steel Water Pipes
16. C206 – Standard for Field Welding of Steel Water Pipe
17. C207 – Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
18. C213 – Standard for Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
19. C214 – Standard for Tape Coatings for Steel Water Pipelines
20. C219 – Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
21. C500 – Standard for Metal-Seated Gate Valves for Water Supply Service
22. C502 – Standard for Dry-Barrel Fire Hydrants
23. C504 – Standard for Rubber-Seated Butterfly Valves
24. C509 – Standard for Resilient-Seated Gate Valves for Water Supply Service
25. C515 – Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
26. C550 – Standard for Protective Epoxy Interior Coatings for Valves and Hydrants
27. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
28. C604 – Standard for Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger
29. C605 – Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
30. C651 – Disinfecting Water Mains
31. C700 – Standard for Cold-Water Meters – Displacement Type, Metal Alloy Main Case
32. C800 – Standard for Underground Service Line Valves and Fittings
33. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm) for Water Transmission and Distribution
34. C901 – Standard for Polyethylene (PE) Pressure Pipe and Tubing 1/2 In. (13 mm) Through 3 In. (76 mm) for Water Service

35. C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm) for Water Transmission and Distribution
 36. C906 – Polyethylene (PE) Pressure Pipe and Fittings 4 in. (100 mm) Through 63 In. (1,600 mm) for Water Distribution and Transmission
 37. M11 – Steel Pipe: A Guide for Design and Installation
 38. M17 – Standard for Installation, Field Testing, and Maintenance of Fire Hydrants
 39. M23 – Standard for PVC Pipe Design and Installation
 40. M41 – Standard for Ductile-Iron Pipe and Fittings
- C. Colorado Department of Transportation (CDOT)
- D. National Fire Protection Agency (NFPA)
- E. Occupational Safety and Health Administration (OSHA)
- F. NSF International:
1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects
 2. Standard 61 – Drinking Water System Components – Health Effects
- G. Surface Preparation Standards (SSPC)
- H. American Welding Society (AWS):
1. D1.1 – Structural Welding Code – Steel
- I. National Association of Corrosion Engineers (NACE):
1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
 2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines
- J. Uni-Bell PVC Pipe Association:
1. Uni-Pub-8: Tapping Guide for PVC Pressure Pipe
- K. Plastics Pipe Institute (PPI):
1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
 2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
 3. Handbook of Polyethylene Pipe
 4. Material Handling Guide
- L. Ductile Iron Pipe Research Association (DIPRA):
1. Thrust Restraint Design for Ductile Iron Pipe
- M. American Railway Engineering and Maintenance-Of-Way Association (AREMA)

N. International Plumbing Code (IPC)

O. International Code Council (ICC)

P. Underwriters' Laboratories (UL)

1.4 SUBMITTALS

A. Submit under provisions of Division 1 Specifications

B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications

C. Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight. Indicate pressure ratings for pipe, fittings, valves

1. Pipe materials
2. Special, fitting, and coupling details
3. Joint restraint system
4. Valves
5. Laying and installation schedule
6. Specifications and data sheets
7. Affidavits of compliance for protective shop coatings and linings

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.

E. Test Reports: Submit reports of field pressure

F. Test Reports: Indicate disinfection results comparative to specified requirements

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications

B. Accurately record actual locations of piping mains, valves, connections, top of pipe elevations, and any mapped or unmapped utilities

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

D. Disinfection report; record:

1. Type and form of disinfectant used
2. Date and time of disinfectant injection start and time of completion
3. Test locations
4. Initial and 24 hour disinfectant residuals (quantity in treated water) in parts per million (ppm) or milligram per liter (mg/L) for each outlet tested
5. Date and time of flushing start and completion
6. Disinfectant residual after flushing in ppm for each outlet tested

E. Bacteriological report; record:

1. Date issued, project name, and testing laboratory name, address, and telephone number
2. Time and date of water sample collection
3. Name of person collecting samples
4. Test locations
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested
6. Coliform bacteria test results for each outlet tested
7. Bacteriologist's signature and authority

1.6 QUALITY ASSURANCE

- A. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years
- B. All pipe, regardless of diameter, shall be supplied by a single manufacturer
- C. Perform Work in accordance with AWWA C651, and the Colorado Department of Public Health and Environment (CDPHE), Larimer County, and City of Loveland
- D. Contractor shall conduct visual inspection before installation
- E. Provide manufacturer's name and pressure rating marked on piping and valves
- F. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational water lines

1.7 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of Larimer County, City of Loveland, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit
- B. Conform to AWWA C651, as appropriate, and CDPHE Design Criteria for Potable Water Systems for performing the work of this Section
- C. In case of apparent conflict, CDPHE requirements govern over these specifications
- D. In absence of State and local regulations, International Plumbing Code applies
- E. NFPA Compliance: Install fire water systems in accordance with NFPA 24 "Standard for the Installation of Private Fire Service Mains and Their Appurtenances"
- F. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service," and are listed by UL.
- G. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1 specifications
- B. Delivery
 - 1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct sunlight
- C. Storage
 - 1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: direct sunlight, mud, etc.
 - 2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
 - 3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
 - a. Do not stack pipe higher than 5 feet
- D. Storage: Use the following precautions for valves, during storage:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage
 - a. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary
- E. Handling
 - 1. Handle so as to insure installation in sound undamaged condition
 - 2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection.
 - 3. Use hooks or straps with broad, well-padded contact surfaces for lifting sections of pipe
- F. Preparation for Transport: Prepare valves, for shipping as follows: Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends, flange faces, and weld ends. Set valves in best position for handling. Set valves closed to prevent rattling
- G. Deliver and store valves and accessories in shipping containers with labeling in place in accordance with AWWA C500
- H. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation
- I. Seal valve ends to prevent entry of foreign materials into valve body
- J. During loading, transporting and unloading, exercise care to prevent damage to material
 - 1. Use nylon slings only
 - 2. Do not drop pipe or fittings

3. Do not roll or skid against pipe already on ground
 4. Repair any damage done to coating or lining
 5. Handle per manufacturer's recommendations
 6. Store rubber gaskets in cool dark location
 7. Store all material on wood pallets or timbers
- K. Adequately tag or otherwise mark all piping, fittings, and valves as to size per AWWA C509, C900, and C905
- L. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner
- M. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner

1.9 JOB CONDITIONS

- A. All work which requires the interruption of active water service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the City of Loveland and coordinated as specified in Division 1
- B. Underground Obstructions
1. Underground Obstructions known to Engineer are shown on Drawings
 - a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
 - b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
 2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
 3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
 - a. Notify Engineer and Owner in case of a conflict
 - b. In case of a conflict, the proposed work may be changed by Engineer
 4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances
- C. Verify existing system operation, pressures, and valve settings (open or closed) prior to construction

PART 2 - PRODUCTS

2.1 PIPE, FITTINGS, AND ACCESSORIES

- A. Comply with the most current City of Loveland standards and specifications for the public water system products and accessories.

2.2 PVC PIPE – 3” DIAMETER

- A. PIPE: ASTM D2241, SDR 21
- B. GASKETS: Elastomeric gaskets, ASTM F477
 - 1. Material: Virgin SBR rubber suitable for potable water conforming to AWWA C111
 - 2. Lubricant shall be suitable for potable water contact

2.3 COPPER TUBING – 3 INCHES OR LESS

- A. COPPER TUBE: ASTM B88; Type K, soft-annealed temper with flared connections.
 - 1. Fittings: Wrought-copper solder-joint fittings, ANSI B16.22; soldered joints, pressure type. Compression fitting will not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions under provisions of Division 1 Specifications
- B. Verify locations and inverts or tops of pipe for connections to existing system as well as crossings with other utilities as indicated on the drawings. Report any discrepancies to Engineer
- C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation
- D. Remove all defective piping from site and replace
- E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work
- F. Start installation only when conditions are satisfactory

3.2 PERFORMANCE - GENERAL

- A. Perform work in a safe and proper manner with appropriate precautions against hazard
- B. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities
- C. Contain all construction activity on the designated site and within the limits of work. Cost of restoration of site will be the responsibility of the Contractor

- D. Contractor to verify quantities to perform all earthwork required according to Drawings, including but not limited to, additional import or export required to handle compaction, pavement subgrade preparation, and pipe bedding
- E. Contractor shall take precautions to limit the removal of or damage to existing pavements, multi-use paths sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted

3.3 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

- A. Excavation and backfill operations shall be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work
- B. Backfill shall be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work
- C. Any excavations improperly backfilled or where settlement occurs shall be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner
- D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, shall be borne by the Contractor at no additional expense to the Owner

3.4 SITE PREPARATION

- A. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris
- B. Remove all waste materials from site and dispose. Stockpile all acceptable grubblings for reuse in revegetation areas.
- C. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted

3.5 DEWATERING

- A. Comply with CDPHE Dewatering Requirements
- B. Dewatering discharge to surface waterways requires CDPHE dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, if necessary

3.6 PIPE PREPARATION

- A. Ream pipe and tube ends and remove burrs

- B. Remove scale and dirt, on inside and outside, before assembly
- C. Cut ends of metallic pipe, recoat with coating approved for potable water service and compatible with manufacturer's coatings.

3.7 BEDDING

- A. Comply with City of Loveland standards and specifications
- B. Excavate pipe trench in accordance with Section 31 00 00 for work of this Section. Do not disturb trench bottom during excavation. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Place bedding material in accordance with Section 31 00 00 at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent. Protect from lateral displacement by placing embedment evenly on both sides of pipe
- D. Provide dewatering and backfill trench in accordance with Section 31 00 00

3.8 PIPE INSTALLATION

- A. Comply with City of Loveland standards and specifications. Use the manufacturer's recommendations if the City of Loveland standards do not specifically apply.
- B. Install PVC Pipe in accordance with AWWA M23 and AWWA C605
- C. Install Ductile Iron Pipe in accordance with AWWA C600
- D. Install Ductile Iron Fittings in accordance with AWWA M41
- E. Route pipe as indicated on the Drawings
- F. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected
- G. Install as specified or in accordance with the manufacturer's recommendations
- H. Cutting Pipe
 - 1. Cut pipe to measurement taken at the site, not from the drawings
 - 2. Cut pipe neatly without damage to pipe
 - 3. Cut smooth, straight, and at right angles to pipe axis
 - 4. Dress and bevel end of cut pipe to remove roughness and sharp corners
 - 5. Cut pipe with saw or abrasive wheel
 - 6. Follow state and federal safety regulations pertaining to cutting asbestos concrete pipe as necessary
- I. Provide an isolation or shutoff valve and union at the water connections to each fixture and unit of equipment, whether shown on the drawings or not

- J. Install pipe to indicated elevations. Maintain minimum 4.5 feet depth of ground cover and maintain minimum grade for drainage. Establish elevations of buried piping to ensure minimum cover is achieved. Maximum depth of 6.0 feet is allowed to avoid a local high point unless shown otherwise on the plans. Add additional soil in areas of future fill to provide minimal cover at all times. Report any variations from plan to Owner and Engineer
 - 1. Provide air release valve at all high points and blow-offs or hydrant at all low points. Coordinate locations and details with Engineer.
 - 2. Where minimum depth cannot be maintained, provide a minimum of 2 inch of specified insulation board per 1 foot of cover not provided. Contractor must have Owner and Engineer approval prior to installation.
 - a. Place insulation board over bedding material for the width of the trench
- K. Install pipe to allow for expansion and contraction without stressing pipe or joints
- L. Protect from lateral displacement by placing embedment evenly on both sides of pipe
- M. Do not lay pipe in water. Maintain groundwater level a minimum of 12 inches below pipe to be installed. Do not lay pipe under unsuitable weather or trench conditions
- N. Make changes in horizontal, vertical, and curved alignment shown on drawings by using joint deflections in the amount permissible by manufacturer and shown on drawings
- O. Do not bend pipe
- P. Deflect pipe at joints
- Q. Do not deflect PVC pipe at connection to ductile iron fittings
- R. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main as indicated on Drawings
- S. Utility crossings
 - 1. Whenever possible, lay water mains over sanitary and storm sewers to provide vertical separation of at least 18-inch between invert of water main and crown of sewer
 - 2. If standard crossing detail is not available and above separation cannot be met, provide one continuous length of watertight sewer pipe 20' long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inch either side of joint or encase sewer pipe in 6-inch of concrete completely around pipe, for not less than 10' either side of water main
 - 3. Water Mains Passing Under Sanitary Sewers: If vertical separation is less than 18-inch, provide structural support for sewer. Provide concrete encasement where water lines pass under sanitary sewer line. Reference detail shown on Drawings
- T. Maintain a minimum 10 feet of horizontal separation and 18 inches of vertical separation between water main and storm or sanitary sewer lines in accordance with the CDPHE

1. Provide concrete encasement if these clearances cannot be achieved and when water line is below sanitary sewer line

U. Tracer wire and marker tape

1. Install tracer wire continuous over top of pipe
2. Install tracer wire test stations behind every fire hydrant or at the end of a dead end run per City of Loveland requirements. Locate test station at fire hydrants, gate valves, or special test station locations in a valve box
3. Terminate tracer wire following drawing details
4. Tape tracer wire to top of pipe using PVC tape every 4 feet along the pipe, and on each side of fitting
 - a. Tape: minimum 2 inches wide and wrapping full circumference of pipe
5. Install identification /warning marker tape in fill area of trench above all water lines

V. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

W. Install access fittings to permit disinfection of water system, subject to approval by Engineer

X. Backfill trench in accordance to specifications herein

Y. Protect pipe from floatation or movement until completely backfilled and put into service

3.9 WATER MAIN CONNECTIONS

A. Comply with City of Loveland standards and specifications. Coordinate with City of Loveland and fire department representatives for any impacts to the existing water system and provide advanced notice to impacted properties if applicable.

B. Connect to water main per plans and referenced standards or details.

3.10 JOINTS

A. Make pipe joints carefully and neatly

B. Connect piping in accordance with manufacturer's recommendations

C. Push-on joints

1. Lay pipe with bell ends facing the direction of laying except when Engineer authorizes reverse laying
2. Assembly of PVC plain end into bell: follow PVC pipe manufacturer's recommendation
3. For PVC pipe, Contractor to ensure that pipe is not inserted into the bell ends beyond the push line
 - a. Utilize EBAA Mega-Stop bell protection, or approved substitution, if necessary, to ensure previously laid pipe joints are not impacted by ongoing installation

4. Lubricate joint surfaces immediately before completing the joint
5. Bevel spigot ends of field cut piping
6. Groove spigot ends of field cut restrained joint piping if required by joint system
7. Install restrained joints following manufacturer's recommendations

D. Mechanical joints

1. Before assembling joint, clean both bell and plain end of rust and foreign matter
2. Assemble joint following AWWA C111, C600, C605 and as specified
3. Lubricate gasket and install in accordance with manufacturer's instructions
4. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble
5. Do not over tighten bolts to compensate for poor installation
6. Carefully align holes in mechanical joints with restraint device to permit installation of the harness bolts
7. Install mechanical joint pieces so the mechanical joint holes straddle the top centerline for horizontal piping, or the side centerline for vertical piping

3.11 PROTECTIVE COATING

A. Provide polyethylene tube encasement on all buried ductile iron fittings, valves, and fire hydrant extensions

1. Encase ductile iron fittings and valves in polyethylene per AWWA C105, Method A, secured with polyethylene compatible adhesive tape. Overlap polyethylene onto PVC pipe a minimum of 6 inches
2. Before backfilling, inspect polyethylene for rips, punctures and other damage and repair following AWWA C105

B. Coat exposed ferrous metal surfaces of joints, couplings, and uncoated steel with primer and tape coating system after installation. Do not coat stainless steel or high strength low alloy steel nuts and bolts

1. Surface Preparation: Clean surfaces of rust, scale, soil, mud, oil, grease, and other contaminants by hand or power tool following SSPC-SP2 or SP3 and other appropriate means as recommended by coating manufacturer Remove excess moisture and provide surface dryness as recommended by coating manufacturer
2. Application: Apply primer in uniform manner to clean and dry surfaces following coating manufacturer's recommendations
 - a. Fill complex and irregular surfaces with appropriate mastic or filler tape to eliminate bridging; then apply tape/wrap to primed and filled surfaces following coating manufacturer's recommendations.
 - b. When coating restraining rods or strapping, apply tape wrap longitudinally
 - c. Where metal being coated enters concrete, overlap coating onto concrete by minimum of 2 inches after placement of concrete
3. Inspection: After field coating of specified items, conduct visual inspection to verify complete coverage has been accomplished.

- a. Repair damaged or incompletely coated surfaces following coating manufacturer's recommendations

C. Metal Surfaces not Protected by Poly Wrap

1. Coat all steel clamp rods, bolts, and other metal accessories used in tapping saddles, anchorages, cut ends of pipe, follower rings and bolts or joint harnesses subject to submergence or contact with the earth and not concrete encased, but including pipe fittings and bolts in polyethylene tube protection
2. Apply 2 coats of coal tar paint to clean, dry metal surfaces, allow first coat to dry before applying second coat

D. Metal Harness Rods

1. Provide field applied primer and Polyken tape wrap

3.12 CONCRETE ENCASEMENT

- A. Provide where indicated on the Drawings
- B. Comply with City of Loveland standards and specifications.
- C. Suitably support and block pipe and anchor against flotation

3.13 CATHODIC PROTECTION

A. Anode installation

1. Fasten anode lead wire to anode by silver solder. Install a minimum of 25 feet of wire. No splicing will be permitted. Insulate connection to a minimum of 600 volts, overlapping lead wire insulation by ½ inch minimum.
2. Provide bonding between pipes and fittings of similar metals to ensure components are electrically continuous.
3. Weld test wires to pipe and terminate at appropriate test station. Both test wires and anode lead wires shall terminate at the cathodic protection test station. No less than two wires shall be installed to the pipe at each site for redundancy. Wires shall be installed in Schedule 80 PVC electrical conduit equipped with duct seal. Install plastic warning tape 12 inches above pipe.
4. Test stations shall be located at the following locations affected or installed during the project:
 - a. At each end of casing under the roadway.
 - b. At each inaccessible insulating pipe joint.
 - c. At intervals not to exceed 1,000 feet.
5. Provide marker posts for test stations located outside of vehicular traffic areas.
6. Restore corrosion protective coatings and wraps damaged during installation, including those on existing pipes.
7. Install wire identification tags.

B. Anode Activation and Field Quality Control

1. A NACE certified Level 2 Cathodic Protection Technician, or equivalent, shall perform all inspection testing under the direct supervision of the Corrosion Engineer.
2. Measure and record the Native Potentials at all cathodic protection test stations.
3. Verify the potentials of all magnesium anodes prior to connecting anodes to pipes.
4. Appropriately connect wires at the test station.
5. Record and explicitly state the shunt rating at each test station.
6. Re-measure potentials at all test stations at last two weeks following initial activation.
7. All test results and records of Native Potentials shall be included in a report describing the cathodic protection system, description of test methods, an analysis of the test data, and conclusions about the systems effectiveness. The report shall be submitted to the Engineer and Owner.
8. Any deficiencies following testing or determined non-compliance with NACE SP0169, shall be communicated in writing to the Engineer and Owner. Any corrections will be the responsibility of the Contractor at no additional cost to the Owner.

3.14 VALVES AND HYDRANTS INSTALLATION

- A. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
 1. Backfill and compact under and around valve boxes to ensure no vertical loads are transmitted to valve operators or bonnets
- C. Comply with AWWA M17 for fire hydrant installation. Install with gate valve and provisions for drainage
- D. Install valves, hydrants, and accessories in accordance with the manufacturer's recommendations and in accordance with referenced standards and specifications.
- E. Hydrants and valves to be set plumb on solid bearing surface
- F. Locate hydrant flange a maximum 4" above adjacent finished grade or flush with the adjacent top of curb. Contractor to verify final grade or adjust flange height upon the completion of final grading.
- G. Drainage shall be provided at the base of the hydrant by placing rock from the bottom of the trench to at least 12 inches above the barrel flange of the hydrant and to a distance of 12 inches around the elbow. The minimum distance from the bottom of the trench to the bottom of the hydrant elbow shall be 6 inches. The minimum amount of rock placed shall be 1/3 cubic yard

3.15 VALVE INSTALLATION

- A. Comply with City of Loveland standards and specifications

- B. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards.
- C. Provide concrete collar for installations within landscaped areas
- D. Protect valve box and cover during paving operations and clean any excess concrete, or asphalt, or road base from valve box and cover to ensure visibility and proper operation

3.16 TAPPING

- A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall be performed in accordance with the applicable sections for saddle tapping as per "Uni-Pub-8: Tapping Guide for PVC Pressure Pipe by Uni-Bell PVC Pipe Association"
- B. All connections requiring a larger diameter than that recommended by the pipe supplier, should be made with a pipe connection as specified and indicated on the drawings.
- C. Equipment used for tapping shall be made specifically for tapping PVC pipe:
 - 1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited

3.17 WATER SERVICES

- A. Water services are to be connected to the new water main per the Contract Drawings and City of Loveland Standards
- B. Water services are to be tapped per the Contract Drawings. Direct taps are not permitted.

3.18 THRUST BLOCKS

- A. Installation:
 - 1. Thrust blocks shall be constructed at bends and fittings that require support due to unbalanced line thrust. Care shall be taken to ensure that outlets, cover bolts, nuts, clamps, and other fittings are accessible. A bond breaker shall be placed between the pipe and the thrust block to aid in future removal. If a large thrust block is to be placed, it shall be separated into sections by a suitable material. Bearing surface areas are minimum areas to bear against the undisturbed trench wall. If the soil bearing capacity is insufficient to provide adequate support based on minimum bearing areas established by Drawing Details, then the minimum bearing area shall be increased to a size that shall ensure support restraint. In every instance, the thrust block shall bear against undisturbed earth
 - 2. Before placing concrete, equipment used in the mixing and transport shall be cleaned. Debris, water, or ice shall be removed from the area to be occupied by concrete. Concrete shall not be placed on frozen subgrade. Concrete shall be placed only in the presence of the Owner or Engineer unless inspection is waived prior to the placement

B. Formwork for Thrust blocks:

1. Forming for concrete thrust blocks and anchors shall be done by bulkheading around the shape of the thrust block or anchor with wood, burlap sacks, or reinforced paper sacks that are filled with sand or earth. Sacks shall be constructed of a size easily handled when full and left in place in the trench. Wood forms shall be removed before backfilling.
2. Horizontal struts or braces required for trench shoring shall not remain in concrete thrust blocks. Prior to placing concrete, the forms and ditch bank will be inspected and approved by Owner or Engineer
3. When concrete is deposited against the ground without the use of forms, the ground shall be thoroughly moistened or other provisions made to prevent the ground from drawing water in from the concrete

C. Thrust block Curing Time:

1. Newly placed concrete shall be allowed to set undisturbed for a minimum of 24 hours

D. Compaction of Fill Over Thrust blocks

1. Backfill may be placed over thrust blocks once the surface has set sufficiently and they are able to resist the weight of the backfill. However, tamping or compacting shall not be allowed above the thrust block for a minimum of 24 hours after placement

E. Hydrostatic testing shall not be conducted until thrust blocks have fully cured, a minimum of 7 days

3.19 ABANDONMENT

A. Cap ends of main as shown. Place required concrete blocking as shown on drawing details

B. Where mains are to be abandoned and removed to a fitting or valve, cut and plug main at fitting or valve

1. When shown on drawings, remove fire hydrants and valves, including lead joint tees when encountered; salvage and deliver removed fire hydrants and valves to the City of Loveland.
2. Pipe, fittings, and other appurtenances that are removed, but are not required to be salvaged become property of Contractor

- a. Remove and dispose of offsite

3.20 ERECTION TOLERANCES

A. Establish invert elevations as shown on the drawings

B. Construct pipe within manufacturer's tolerances of horizontal and vertical deflection. Refer to City of Loveland for allowable deflections at joints and fittings.

3.21 FIELD QUALITY CONTROL

- A. Comply with City of Loveland standards and specifications. Test each line at the Contractor's expense in the presence and to the satisfaction of City of Loveland inspectors.
- B. Field inspection and testing will be performed under provisions set forth by the referenced standards
- C. Test each line at the Contractor's expense in the presence and to the satisfaction of Owner or Engineer at a maximum of 1,000 foot intervals
- D. Water Line Disinfection
 - 1. Comply with AWWA C651 and provide Engineer and Owner with results.
 - 2. Flush water lines prior to disinfection, except when tablet method is used. Acceptable chlorine disinfectants are calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite solutions, and calcium hypochlorite tablets.
 - 3. After the pipe is filled with water and chlorine, the chlorinated water shall be held in contact with the pipe for 24 hours. At the end of the 24 hour period, the water in the pipeline shall be tested by the local health authority having jurisdiction, or their designated representative, to ensure a residual chlorine content in compliance with City of Loveland requirements. The pipeline shall then be thoroughly flushed to remove the heavily chlorinated water. This activity requires a permit from the CDPHE WQCD prior to flushing. Comply with all provisions of the permit. Care shall be taken in flushing the pipeline to prevent property damage and danger to the public. Discharges of water from blowoff assemblies or other appurtenances shall be contained or discharged in a manner approved by City of Loveland and the CDPHE.
 - 4. For fire lines, flush piping complying with NFPA 24
 - 5. If water in pipe does not meet the governing agency requirements, repeat disinfection procedure until acceptable. Furnish copies of acceptance forms from governing agency to Owner and Engineer.
- E. Valve Testing
 - 1. Conduct pressure and leakage tests on all newly installed valves
 - 2. Furnish all necessary equipment and material and make all connections to the pipe, as required. The Engineer shall monitor the tests.
- F. Hydrostatic Pressure Testing
 - 1. Provide all necessary pumping equipment, piping connections, pressure gauges with maximum of 5 psi increments, and other required equipment, facilities, and materials.
 - 2. Test only using potable water in conformance with [Town, City, District] standards.
 - 3. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
 - 4. Hydrostatic Test Conditions: At lowest point in the line or section under test, pressurize to 150 psi minimum. The pipeline shall be filled at a rate that does not create surges and does not exceed the rate at which air can be released.
 - 5. While the test pressure is maintained, an examination shall be made of the pipeline and any leaks located and repaired. Pipe or fittings found to be faulty shall be removed and

replaced. Leakage is not allowed through the bonnet of the line valve. A valve leaking through the bonnet may be repaired in place or removed and replaced. Cutting and replacement of pavement as well as excavation and backfilling may be necessary when locating and repairing leaks discovered during pressure testing.

6. After visible leaks are stopped, the full test pressure shall be maintained for 1 continuous hour. Allowable leakage for each section between line valves shall not exceed City of Loveland requirements.

3.22 CLEANING

- A. Verify that piping has been cleaned and inspected
- B. Verify that piping has been successfully pressure tested and flushed
- C. Perform scheduling and disinfection activity with start-up, testing, adjusting, demonstration procedures, including coordination with related systems

3.23 DISINFECTION

- A. Provide and attach required equipment to perform the work of this Section
- B. Tablet, continuous, or slug disinfection may be followed in accordance with AWWA C651
- C. The preferred method is continuous disinfection, summarized as follows:
 1. Inject treatment disinfectant, free chlorine in liquid form into piping system to obtain 50 to 80 ppm residual
 2. Bleed water from outlets to ensure distribution and test for disinfectant residual
 3. Maintain disinfectant in system for 24 hours
 4. If final disinfectant residual tests less than 25 ppm, repeat treatment
 5. Flush, circulate and clean until residual equal to that of incoming potable water or 1.0 mg/L is achieved
- D. Replace permanent system devices removed for disinfection

3.24 FINAL FLUSHING

- A. Maintain a flushing velocity of 2.5 feet per second in piping
- B. Collect chlorinated water for proper disposal and/or dechlorinate to less than 0.1 ppm free chlorine prior to discharge in accordance with State, County, and local regulations

3.25 DISINFECTION FIELD QUALITY CONTROL

- A. After final flush, and before main or equipment is placed in service, collect water samples from representative points along the main and field test for chlorine residual
- B. Chlorine residual shall be within 50 percent of the chlorine residual prevailing in the source

- C. If initial disinfection fails to provide satisfactory samples, repeat disinfection until satisfactory samples have been obtained

3.26 DISINFECTION TESTING AND ACCEPTANCE

- A. The Contractor will perform Bacteriological (Bac-T) sampling and testing after pipes have been disinfected and flushed as specified herein
- B. If any portion of the piping or equipment or tanks fails Bac-T testing, the Contractor is responsible for repeating disinfection procedures until passing Bac-T test is obtained

3.27 FINAL ACCEPTANCE

- A. Comply with City of Loveland standards and specifications for placing water line in service
- B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
 - 1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete
- C. Drain all test water from the new pipe system prior to placing in service
- D. Provide water tap locations as shown on the Drawings
- E. Provide operation and maintenance manuals for air and line valves and fire hydrants
- F. Provide final reports to Engineer for:
 - 1. Bac-T results
 - 2. Residual chlorine tests
 - 3. Hydrostatic tests for each section or pipe
 - 4. Cathodic protection system test(s)
 - 5. Tracer wire continuity test

END OF SECTION 331000

SECTION 333300 – SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Polyvinyl chloride (PVC) non-pressure pipe for gravity sanitary sewer with all jointing materials, fittings, and other appurtenances required for a complete installation
- B. All precast manholes complete with steps, ring and cover as required

1.2 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A48 – Standard Specification for Gray Iron Castings
 - 2. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 3. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - 4. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
 - 5. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 6. C33 – Standard Specification for Concrete Aggregates
 - 7. C150 – Standard Specification for Portland Cement
 - 8. C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - 9. C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
 - 10. C497 – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 - 11. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
 - 12. C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete manhole Structures, Pipes, and Laterals
 - 13. C1227 – Standard Specification for Precast Concrete Septic Tanks
 - 14. C1619 – Standard Specification for Elastomeric Seals for Joining Concrete
 - 15. C1821 – Standard Practice for Installation of Underground Circular Precast Manhole Structures
 - 16. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - 17. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
 - 18. D1330 – Standard Specification for Rubber Sheet Gaskets
 - 19. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
 - 20. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC)

21. D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
22. D2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
23. D2240 – Standard Test Method for Rubber Property – Durometer Hardness
24. D2321 – Standard Specification for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
25. D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
26. D2774 – Standard Specification for Underground Installation of Thermoplastic Pressure Piping
27. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
28. D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
29. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
30. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
31. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
32. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
33. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
34. F412 – Standard Terminology Relating to Plastic Piping Systems
35. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
36. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
37. F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
38. F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
39. F2164 – Standard Specification for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

B. American Water Works Association (AWWA):

1. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. C115 – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
5. C150 – Standard for Thickness Design of Ductile-Iron Pipe
6. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast
7. C504 – Standard for Rubber-Seated Butterfly Valves
8. C512 – Standard for Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
9. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
10. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

11. C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution
 12. M23 – PVC Pipe: Design and Installation
- C. Colorado Department of Transportation (CDOT)
 - D. Occupational Safety and Health Administration (OSHA)
 - A. American Welding Society (AWS):
 1. D1.1 – Structural Welding Code – Steel
 - B. National Association of Corrosion Engineers (NACE):
 1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
 2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines
 - C. Plastics Pipe Institute (PPI):
 1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
 2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
 3. Handbook of Polyethylene Pipe
 4. Polyethylene Piping Systems Field Manual for Municipal Water Applications
 5. Material Handling Guide
- 1.4 SUBMITTALS
- A. Submit under provisions of Division 1 Specifications
 - B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications
 - C. Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight.
 1. Pipe materials
 2. Special, fitting, and coupling details
 3. Gasket materials
 4. Valves
 5. Laying and installation schedule
 6. Specifications and data sheets
 7. Affidavits of compliance for protective shop coatings and linings
 - D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.
 - E. Test Reports: Submit reports of field exfiltration/infiltration, mandrel and lamp tests under provisions of Division 1 Specifications

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1 Specifications
- B. Accurately record actual locations of piping mains, valves, connections, invert elevations, and any mapped or unmapped utilities
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Loveland and CDPHE Stormwater and/or Groundwater Discharge Permit, notes on the drawings and as specified herein.
- B. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years
- C. All PVC pipe, regardless of diameter, shall be supplied by a single manufacturer
- D. Perform Work in accordance with the Colorado Department of Public Health and Environment (CDPHE) and Larimer County
- E. Contractor shall conduct visual inspection before installation
- F. Provide manufacturer's name and pressure rating marked on piping and valves
- G. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational sewer lines

1.7 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of Larimer County, City of Loveland, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit
- B. In case of apparent conflict, CDPHE requirements govern over these specifications
- C. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1 Specifications
- B. During loading, transporting and unloading, exercise care to prevent damage to material
 - 1. Use nylon slings only
 - 2. Do not drop pipe or fittings
 - 3. Do not roll or skid against pipe already on ground
 - 4. Repair any damage done to coating or lining

5. Handle per manufacturer's recommendations
 6. Store rubber gaskets in cool dark location
 7. Store all material on wood pallets or timbers
- C. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner
- D. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner
- E. Pipe
1. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation
 2. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling PVC pipe during cold weather
 3. Do not store PVC pipe uncovered in direct UV light
 4. Pipe stored along the trench side shall be suitably supported off the ground to avoid damage to the coating
- F. Valves
1. Prepare valves for shipping as follows:
 - a. Ensure that valves are dry and internally protected against rust and corrosion
 - b. Protect valves against damage to threaded ends, flange faces, and weld ends
 - c. Seal valve ends to prevent entry of foreign materials into valve body
 - d. Set valves in best position for handling
 - e. Set valves closed to prevent damage
 2. Deliver and store valves and accessories in shipping containers with labeling in place
 3. Storage: Use the following precautions for valves during storage:
 - a. Do not remove end protectors unless necessary for inspection; then reinstall for storage
 - b. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary
- G. Precast Concrete Structures
1. Transport and handle precast concrete units with equipment to protect from dirt and damage
 2. Do not place precast concrete units in position which will cause damage
 3. Handle precast concrete structures by means of lifting inserts. Do not move from manufacturer's yard until curing is complete.

1.9 JOB CONDITIONS

- A. All work which requires the interruption of active sanitary sewer service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the City of Loveland and coordinated as specified in Division 1

B. Underground Obstructions

1. Underground Obstructions known to Engineer are shown on Drawings
 - a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
 - b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
 - a. Notify Engineer and Owner in case of a conflict
 - b. In case of a conflict, the proposed work may be changed by Engineer
4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

PART 2 - PRODUCTS

2.1 PIPE, MANHOLES, AND ACCESSORIES

- A. Comply with City of Loveland standards and specifications.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine pipe and fittings and do not use individual sections containing cracks, dents, abrasions, and other defects

3.2 INSTALLATION OF HDPE PRESSURE PIPE

- A. Trenching, Pipe Embedment, Backfill, and Compaction: See Section 31 00 00
- B. Pipe and Fittings
 1. Follow pipe manufacturers installation instructions for field cutting and fusion joining techniques for HDPE pipe
 - a. Include acceptable size and shape of fusion bead; and minimum radius of curvature of various sizes of pipe for installing curved sections of pipe
 2. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
 3. Do not dump or drop pipe or accessories into trench
 4. Lay to lines and grades indicated on drawings or as specified
 - a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
 - b. Join to form a smooth flow line

5. Do not install flanges, fittings, or valves in curved sections of pipe
6. Keep pipe clean during and after laying
7. Close all open ends with watertight expandable type sewer plugs or test plugs
8. Do not lay pipe when
 - a. There is water in the trench
 - b. Trench conditions are unsuitable
 - c. Weather conditions are unsuitable
9. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
10. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 31 00 00
11. Protect pipe from hot and cold thermal expansion using manufacturer and other recommended techniques

C. Joining

1. Use butt fusion joining technique for connections between pipe sections or fittings unless otherwise noted herein.
2. Butt Fusion
 - a. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground.
 - b. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations.
 - c. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.
 - d. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
3. Sidewall Fusion
 - a. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications.
 - b. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused.
 - c. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
4. Mechanical
 - a. Bolted joining may be used where the butt fusion method cannot be used.
 - b. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring.
 - c. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as manufactured by JCM Industries, Inc.
 - d. Either mechanical joint joining method will have a ductile iron mechanical joint gland.
5. Other
 - a. Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

D. Water Line and Sanitary Sewer Crossings

1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.
3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer

3.3 INSTALLATION OF PVC GRAVITY SANITARY SEWER PIPE (NON-PRESSURE)

A. Trenching, Pipe Embedment, Backfill, and Compaction: See Section 31 00 00

B. Install pipe in accordance with ASTM D2321 as modified herein or on the drawings

C. Cutting

1. Cut and bevel ends in accordance with manufacturer's standard recommendations
2. Machine cut ends smooth and square to proper dimensions
3. Do not cut with a cold chisel, iron pipe cutter, flame or any other method that may fracture the pipe or leave ragged, uneven edges
4. Remove burrs and wipe off all dust and dirt from jointing surfaces

D. Pipe Laying

1. Inspect pipe and accessories for cracks and other defects before lowering into trench
2. Repair or replace any defective, damaged or unsound pipe
3. Remove all dirt and foreign material from the inside of pipe before laying
4. Check bedding for firmness and uniformity of surface immediately before laying each section of pipe
5. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
6. Do not dump or drop pipe or accessories into trench
7. Lay to lines and grades indicated on drawings or as specified
 - a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
 - b. Closely joint to form a smooth flow line
 - c. Place bell end or groove ends of piping facing upstream
 - d. Maximum length of pipe that can be used without exceeding the allowable deflection at a coupling shall be determined
 - e. Maximum deflection at flexible couplings as recommended by the manufacturer
 - f. Maximum deflection at a joint: As recommended by the manufacturer, but not more than 3-1/2 inches
8. Utilize implements, tools, and facilities as recommended by the manufacturer
9. Keep pipe clean during and after laying
10. Close all open ends with watertight expandable type sewer plugs or test plugs
11. Remove and relay any pipe which has floated

12. Do not lay pipe when
 - a. There is water in the trench
 - b. Trench conditions are unsuitable
 - c. Weather conditions are unsuitable
13. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
14. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 31 00 00

E. Jointing

1. Assemble in accordance with the manufacturer's instructions
2. Wipe clean pipe ends, gasket and gasket groove before inserting gasket
3. Apply lubricant furnished by the pipe manufacturer to the gasket and the outside of the spigot end
4. Utilize an assembly tool as recommended by the manufacturer to center the sleeve over the spigot end
5. Insert the spigot end to the reference mark
6. Check gasket location after assembly with a suitable gage
 - a. Gasket locations to be the distance from the sleeve and recommended by the coupling manufacturer for their full circumference
 - b. If not within the required limits, disassemble and reassemble the joint

F. Fittings

1. Install utilizing standard methods
2. Lower into trench with rope or other means to prevent damage
3. Attach rope around the exterior
4. Do not attach rope through the interior
5. Carefully connect to pipe or other facility
6. Check joint to insure a sound and proper joint

G. Water Line and Sanitary Sewer Crossings

1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.
3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer

3.4 INSTALLATION OF HATCH

- A. The installer shall comply with the hatch Manufacturer's installation instructions

3.5 MANHOLE PREPARATION

- A. Verify items provided by other section of Work are properly sized and located
- B. Verify that built-in items are in proper location, ready for roughing into Work
- C. Verify excavation for manholes is correct
- D. Excavation, Backfill, Subgrade Compaction: Refer to Section 31 00 00 for requirements
- E. Rock Subbase
 - 1. Remove water and place 6-inch minimum depth
 - 2. Vibrate for compaction
 - 3. Level top to accept precast sections with uniform bearing all around
 - 4. If material below vault is unsuitable, excavate as directed by the Engineer and backfill to grade with 1-1/2 inch minus rock and compact

3.6 PLACING MANHOLE

- A. Place base pad, trowel top surface level to accept manhole section with uniform bearing all around
- B. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base of place first manhole section directly in wet concrete
- C. Place manhole sections plumb and level, trim to correct elevations
- D. Clean ends of sections and place double mastic gasket
- E. Fill inside and outside of joint completely with non-shrink grout and trowel smooth
- F. Cure non-shrink grout using approved methods outlined in Division 3 Specifications.
- G. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Engineer
- H. Completed manholes shall be rigid and watertight
- I. Coordinate with other sections of work to provide correct size, shape, and location

3.7 PREFORMED GASKETS

- A. Remove and replace manhole sections which have chipped or cracked joints
- B. Thoroughly clean section joints
- C. Install gasket in conformance with manufacturer's recommendations
- D. Only use primer furnished by gasket manufacturer

3.8 MANHOLE INVERT

- A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench 1 inch per foot for drainage to invert.
- B. Invert shape to conform to radius of pipe it connects
- C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert
- D. Construct in conformance with standard drawings

3.9 MANHOLE RINGS AND COVERS

- A. Place rings in bed of non-shrink grout on top of manholes
- B. Ensure no infiltration will enter manhole at this location
- C. Carry non-shrink grout over flange of ring
- D. Set top of ring flush with all surfaces subject to foot and vehicular traffic
- E. Set manhole ring and cover 1/4-inch to 1/2-inch below roadway surface
- F. Use precast grade rings for height adjustment of manhole ring and cover

3.10 CONNECTION TO EXISTING MANHOLES

- A. Maintain flow at all times
- B. Prior approval of proposed method for maintaining flow must be obtained from Engineer
- C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure
- D. Make connection during low flow periods

3.11 FIELD QUALITY CONTROL – PIPE

- A. Exfiltration/Infiltration Test
 - 1. Perform an exfiltration test on each reach of sanitary service and sewer pipe between manholes or discharge
 - a. Test the first reach prior to backfilling and before installing any of the remaining pipe
 - b. Provide all necessary piping between the reach to be tested and the water supply, together with all required materials and equipment
 - c. Methods used, scheduling, and duration of tests shall be acceptable to Engineer
 - d. Air testing may be allowed: Submit complete information to Engineer for review describing the proposed test method including the method of testing manholes before beginning testing

2. Procedure
 - a. Block off all manhole openings except those connecting with the reach under test
 - b. Fill the line
 - i) Average depth: 10 feet above invert except as required by manhole depth
 - ii) Maximum depth at lower end: 25 feet above crown
 - iii) Minimum depth at upper end: 5 feet above crown
 - c. Add and measure water as required to maintain a constant level
 - i) Maximum exfiltration/infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
 - ii) Manholes considered section of 48-inch pipe
 - iii) Maintain test for at least 2 hours or as long as necessary, in the inspector's opinion, to locate all leaks

3. Repair and retest any reach which exceeds the allowable exfiltration/infiltration

B. Infiltration

1. At any time prior to expiration of the correction period, infiltration exceeds 0.039 gallons per inch of nominal diameter per 100 feet per hour, locate the leaks and make repairs

C. Pipe Deflection Test

1. No sooner than 30 days after placement and compaction of backfill, but prior to placement of permanent surface materials, clean and mandrel each line to detect obstructions (deflections, joint offsets, lateral pipe intrusions, etc.)
2. Use a rigid mandrel with diameter of at least 95 percent of the pipes specified average inside diameter and a length of the mandrel circular portion at least equal to the nominal pipe diameter
3. Maximum allowable deflection is 5 percent of the base internal diameter. Mandrel outside diameters in inches are as follows:

Pipe Size	Base I.D.	Mandrel O.D.
6	5.792	5.50
8	7.764	7.38
10	9.711	9.23
12	11.558	10.98

4. Pull the mandrel through the pipe by hand
5. Relay or replace all pipe exceeding the 5 percent deflection at no additional cost to the Owner
6. Retest repaired sections
7. Maximum allowable deflection at end of one year correction period, 7-1/2 percent of the base internal diameter tested in the same manner. Uncover and repair sections exceeding the allowable deflection

- D. All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights.

E. Lamp Test

1. Each section between manholes will be lamped by Contractor in the presence of engineer
2. A true circle will be required in the lamp tests to indicate a properly constructed sewer line
3. Repair any sections not passing the lamp test at Contractor's expense.

3.12 FIELD QUALITY CONTROL – MANHOLES

A. Test all manholes:

1. Vacuum test:
 - a. Plug all inlets and outlets in such a manner as to prevent displacement of plugs
 - b. Install and operate vacuum tester head assembly in accordance with equipment specifications and manufacturer instructions
 - c. Attach the vacuum pump assembly to the proper connection on the test head assembly. Ensure that vacuum inlet/outlet valve is closed
 - d. Inflate sealing element to twice the pressure test to be used. Do not over inflate
 - e. Start vacuum pump assembly engine and allow preset RPM to stabilize
 - f. Open vacuum inlet/outlet valve and evacuate manhole to 5-inches Hg (mercury)
 - g. Close vacuum inlet/outlet valve, disconnect vacuum pump and monitor vacuum. Record time for vacuum to drop from initial 5 inches Hg to 4 inches Hg.
 - h. Acceptance for 5 foot diameter manhole is when the time to drop from 5 inches Hg to 4 inches Hg meets or exceeds requirements as defined below:

Maximum Allowable Vacuum Drop		
Manhole Depth Rim to Invert	Manhole Diameter in feet	Time for Vacuum to Drop 1 inch Hg
10 feet or less	5	150 seconds
10 feet to 15 feet	5	180 seconds
15 feet to 25 feet	5	210 seconds

- i. Adjust time to drop from 5 inches Hg to 4 inches Hg for other manhole diameters as follows:
 - i) 4 foot diameter manhole: Subtract 30 seconds from time shown above
 - ii) 6 foot diameter manhole: Add 30 seconds to time shown above
 - j. Repair all manholes that fail leakage test and retest until manhole passes test at no additional cost
 - k. If joint mastic or gasket is displaced during vacuum test, disassemble manhole and replace seal
 - l. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn, Retesting shall proceed until a satisfactory test is obtained.
2. All testing shall be witnessed by Engineer. Contractor shall provide a minimum of 48 hours notice to Engineer prior to testing.

3.13 CLEANUP AND RESTORATION

- A. Restore pavements, curbs and gutters, utilities, and other improvements to condition equal to or better than before work began and to satisfaction of Engineer.
- B. Deposit waste material in designated waste areas and disposal site graded and shaped.

3.14 FINAL ACCEPTANCE

- A. Comply with City of Loveland standards and specifications for placing sewer line in service
- B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
 - 1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete
- C. Provide record drawings with manhole number, inverts, and location (x, y, z) for each service connection
- D. Provide test report for tracer wire continuity
- E. Provide pipe and manhole tests and results

END OF SECTION 333300

SECTION 334000 – STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping and concrete structures for storm sewer system, roof drainage, and culverts
- B. Riprap for channel lining, outlet protection and rock check dams

1.2 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork
- B. Section 03 42 00 – Precast Concrete Structures

1.3 REFERENCES

- A. ACPA - American Concrete Pipe Association
- B. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C. ASTM C150 - Portland Cement
- D. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- E. ASTM C478 – Precast Concrete Structures
- F. ASTM C497 - Testing Concrete Pipe, Manhole Sections, or Tile
- G. ASTM A48 - Gray Iron Castings
- H. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- I. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- J. ASTM C33 - Concrete Aggregates
- K. ASTM C478 - Precast Reinforced Concrete Manhole Sections
- L. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District (UDFCD)
- M. Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction

1.4 DESIGN REQUIREMENTS

- A. Comply with applicable requirements of ASTM C76

- B. Comply with City of Loveland, Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District (UDFCD), and CDPHE Stormwater and/or Groundwater Discharge Permit and related storm design criteria. If standards conflict, the more stringent criteria shall govern.

1.5 SUBMITTALS

- A. Submit under provisions of Division One Specifications
- B. Shop Drawings: Provide drawings with pipe and structure details, design standards, reinforcement, dimensions, etc. Provide additional detailed information (including elevations, fittings, specialty materials or fabrications, etc.) for special or custom features, structures, junctions and/or pipes. Provide pipe-laying schedule.
- C. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications.
- D. Manufacturers Certificate: Certify that pipe, meets or exceeds specified requirements. Confirm all materials comply with applicable standards.
- E. Test Reports: Submit all shop and field test reports in accordance with Division One Specifications Product Data:
- F. Provide sufficient data to verify compliance with these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery
 - 1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun
- B. Storage
 - 1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: (direct sunlight, mud.. etc)
 - 2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
 - 3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
 - a. Do not stack pipe higher than 5 feet
- C. Handling
 - 1. Handle so as to insure installation in sound undamaged condition.
 - 2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection
 - 3. Use hooks or straps with broad, well padded contact surfaces for lifting sections of pipe

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Weather limitations: Do not install piping over frozen surfaces or in standing water.

PART 2 - GENERAL PRODUCTS

2.1 PIPE MATERIALS

- A. Comply with City of Loveland standards and specifications for public storm sewer products.
- B. General: Provide pipes of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated
- C. Fittings: Furnish bends, ells, tees, wyes, couplings and other fittings of the same type and class of material having equal or superior physical and chemical properties as acceptable to the Engineer
- D. Reinforced Concrete Pipe: ASTM C76,
 - 1. 12-inch RCP Class V, with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 - 2. 15-inch RCP Class IV (Class V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 - 3. 18-inch thru 24-inch RCP Class III (Class IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 - 4. 24-inch thru 36-inch RCP Class II (Class III, IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
- E. PVC Sewer Pipe: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.
- F. HDPE Sewer Pipe: smooth interior, corrugated exterior piping conforming to ASTM D 2412, ASTM D 3212, AASHTO specifications M252 and M 294, joints to conform to ASTM F 477.

2.2 MATERIALS

- A. Comply with City of Loveland standards and specifications for public storm sewer products.
- B. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Engineer for pipe stubouts.
- C. Cleanouts: Provide as indicated, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the word "STORM".
- D. Reinforcement
 - 1. Reinforcing Steel: ASTM A615 Grade 60
 - 2. Welded Wire Fabric: ASTM A185
- E. Concrete: Refer to Division Three Specifications
 - 1. Minimum compressive strength: 5000 psi at 28 days
 - 2. Cement: ASTM C150, Portland Cement, Type II

3. Aggregates: ASTM C33, free of deleterious substances

F. Gaskets: ASTM C923

1. Mastic: FS SS-S-210A, "RAM-NEK" or accepted substitution
2. Rubber: Neoprene, 40± 5 hardness when measured by ASTM D2240, Type A durometer

G. Inlet Gratings and Manhole Rings and Covers

1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces
2. Provide bike/pedestrian-safe grates where such traffic is anticipated
3. Set grate on frame such that openings maximize inlet intake
4. Covers to seat at all points on ring
5. Covers to be cast with "STORM" in 2" tall flush letters
6. Manhole covers to receive asphalt varnish coating hot dip applied at foundry, 6 mils thick

H. Manhole Height Adjustment: Use precast concrete grade rings

I. Rock Subbase: 1-1/2 inch minus, well-graded gravel over compacted subgrade

J. Water: Clean and free of deleterious substances

K. Grout:

1. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days
2. Epoxy Grout: Three Component Epoxy Resin System
 - a. Two liquid epoxy components
 - b. One inert aggregate filtered component
 - c. Each component furnished in separate package for mixing at job site

2.3 CONCRETE CATCH BASINS AND MANHOLES

A. Comply with City of Loveland standards and specifications for public storm sewer products.

B. Precast Concrete Units:

1. Manufacturers: Carder Concrete Products, Amcor Precast, or accepted equal
2. Specification: ASTM C478 and C789, wall "B"
3. Minimum wall thickness: greater of 6 inch 1/12 of internal diameter
4. Reinforced
5. Grade rings as required
6. Cast steps into units.

C. Precast Units or Cast-in-place as shown. Use concrete that will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan or sawcut in field.

- D. Cast-in-place Concrete Units: As shown on the drawings complying with the City of Loveland and Colorado Department of Transportation drainage and design standards.
- E. Manhole Steps: Steel bar, 1/2 inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF" or equal

2.4 PVC PLASTIC INLINE DRAINS AND DRAIN BASINS

- A. Manufacturer: Nyloplast America Inc. or accepted substitution.
- B. Inline drains and drain basins shall be manufactured from PVC pipe stock, utilizing a thermo molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212.
- C. Surface drainage products shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.
- D. Inline drain and drain basin adapters and accessories
 - 1. Adaptable to SDR-35 PVC piping.
 - 2. Watertight adaptors.
- E. Cast iron or ductile iron frames and grates:
 - 1. Light –traffic rated
 - 2. Pedestrian rated
 - 3. Hinged and locking
 - 4. Made specifically for use with the specified inline drains and drain basins
 - 5. Painted black
 - 6. ASTM A-48-83 Class 30B or A536 grade 70-50-05 grade iron
 - 7. Size indicated on the drawings

2.5 CONCRETE FABRICATION

- A. Comply with City of Loveland standards and specifications for public storm sewer products.
- B. Vault/Manhole Sections
 - 1. Precast concrete dimensions as shown on plans
 - 2. Minimum manhole inside diameter: 48 inch
 - 3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H20 loading
 - 4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
 - 5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly
 - 6. Access opening: Minimum 24 clear or as indicated
 - 7. Pipe connection: As indicated on Drawings
 - 8. Pipe knockout: As indicated on Drawings

9. Precast concrete, monolithic base or cast-in-place base
10. Manhole steps: 12 inch on center, vertical alignment above largest bench or open area

C. Grating and Metal Frame: As specified on drawings

2.6 SOIL MATERIALS

A. Comply with City of Loveland standards and specifications for public storm sewer products.

B. Furnish pipe bedding and cover as specified in Section 31 00 00 – Earthwork.

C. Riprap Materials:

1. Hard, dense, durable stone, angular in shape and resistant to weathering
2. Minimum specific gravity of 2.5
3. Material may be approved by Engineer, if by visual inspection, the rock is determined to be sound and durable
4. Engineer may require Contractor to furnish laboratory test results if the material appears to be marginal or unacceptable
5. Tested material shall meet the following requirements for abrasion resistance or compressive strength:

Test	Test Method	Requirement
Abrasion Resistance by Los Angeles Machine	ASTM C 535	50% loss, max
Unconfined Compressive Strength of Drilled Core Specimen	AASHTO T 24	2500, min

6. Contractor shall provide a five ton sample of riprap indicating the compliance to required material soundness and gradation specifications if requested by the Engineer.

7. Gradation:

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	Mean Particle Size, d_{50} (Inches)
Type L	70-100 50-70 35-50 2-10	15 12 9 3	9
Type M	70-100 50-70 35-50 2-10	21 18 12 4	12
Type H	70-100 50-70 35-50 2-10	30 24 18 18 6	18

8. Granular Riprap Bedding:

a. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4"	90-100
1/2"	25-60
3/8"	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

D. Pipe Bedding:

1. Refer to Section 31 00 00 – Earthwork
2. Minimum 6 inch deep, unless specified otherwise

E. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

PART 3 - EXECUTION

3.1 REGULATORY REQUIREMENTS

- A. Comply with City of Loveland standards and specifications for public storm sewer installation.

3.2 PIPE PREPARATION

- A. Shape trench and place bedding as specified in Section 31 00 00 and as shown on the drawings.

1. Dig bell or coupling holes
2. Do not support pipe on blocks or mounds of earth.
3. Provide uniform and continuous bearing and support for full length of pipe between bell holes
4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle

B. Alignment and Grade

1. Except as indicated on the Drawings, lay all pipe straight and at a uniform grade.
2. Use batter boards to determine and check pipe subgrades.
3. Other methods of maintaining alignment and grade may be acceptable if approved by the Engineer.

3.3 PIPE INSTALLATION

- A. Inspect pipe and accessories for defects before lowering into trench.
- B. Replace any defective, damaged or unsound pipe.
- C. Carefully lower pipe, fittings, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage. Do not dump or drop pipe or accessories into trench.
- D. Pipe embedment shall be as specified in Section 31 00 00 for pipe.
- E. Protect from lateral displacement by placing the specified pipe embedment material.
- F. Do not lay pipe in water, under unsuitable weather conditions or under unsuitable trench conditions
- G. Joint to form true and smooth line.
- H. Remove any pipe not making a good fit.
- I. Begin pipe laying at the lowest point unless reverse laying is accepted by Engineer.
- J. Utilize implements, tools and facilities as recommended by the manufacturer and/or catch basins if required to remove debris.
- K. Keep pipe clean during and after laying.
- L. During construction, close all open ends with watertight expandable type plugs.
 - 1. At the end of each day's operations.
 - 2. Whenever pipe ends are left unattended.
 - 3. Deposit adequate backfill on pipe to prevent flotation.
 - 4. Do not use wood, burlap or other similar temporary plugs.
- M. Remove and re-lay any pipe which has floated.

3.4 PRECAST STRUCTURE PREPARATION

- A. Verify items provided by other section of Work are properly sized and located
- B. Verify that built-in items are in proper location, ready for roughing into Work
- C. Verify excavation for manholes is correct
- D. Excavation and Backfill: Refer to Section 31 00 00 - Earthwork for requirements
- E. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections
- F. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction

3.5 CATCH BASINS

- A. Construct catch basins to the sizes and shapes indicated, and to conform to requirements of authorities having jurisdiction.
 - 1. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction
 - 2. For precast units, set in place to accurate elevations on firm, solid bed, plumb and level.
 - 3. Pipe openings, elevations and alignment per plans
 - 4. Seal and grout all pipe penetrations
 - 5. Set cast iron frames and gratings to the elevations indicated.

3.6 PLACING MANHOLE SECTION OR CAST-IN PLACE BASE

- A. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction
- B. Place base pad, trowel top surface level to accept manhole section with uniform bearing all around
- C. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base or place first manhole section directly in wet concrete
- D. Place manhole sections plumb and level, trim to correct elevations
- E. Clean ends of sections and place double mastic gasket
- F. Fill inside and outside of joint completely with non-shrink grout and trowel smooth
- G. Cure non-shrink grout using approved methods
- H. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Engineer
- I. Completed manholes shall be rigid and watertight
- J. Coordinate with other sections of work to provide correct size, shape, and location

3.7 PREFORMED GASKETS

- A. Remove and replace manhole sections which have chipped or cracked joints
- B. Thoroughly clean section joints
- C. Install gasket in conformance with manufacturer's recommendations
- D. Only use primer furnished by gasket manufacturer

3.8 MANHOLE INVERT

- A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench 1 inch per foot for drainage to invert.
- B. Invert shape to conform to radius of pipe it connects
- C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert
- D. Construct in conformance with standard drawings

3.9 MANHOLE RINGS AND COVERS

- A. Place rings in bed of non-shrink grout on top of manholes
- B. Ensure no infiltration will enter manhole at this location
- C. Carry non-shrink grout over flange of ring
- D. Set top of ring flush with all surfaces subject to foot and vehicular traffic
- E. Set top of ring 6 inches above surfaces in open, unraveled, non-pedestrian areas
- F. Use precast grade rings for height adjustment

3.10 CONNECTION TO EXISTING MANHOLES

- A. Maintain flow at all times
- B. Prior approval of proposed method for maintaining flow must be obtained from Engineer
- C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure
- D. Make connection during low flow periods

3.11 GROUT

A. PREPARATION

- 1. Non-Shrink, Non-Metallic Grout, General Use
 - a. Clean concrete surface to receive grout
 - b. Saturate concrete with water for 24 hrs prior to grouting and remove excess water just prior to placing grout
 - c. Cold weather conditions
 - i. Warm concrete, substrate and base plate to 40 deg F, or above; store grout in warm area
 - ii. Follow manufacturer's recommendations for cold weather application
 - d. Hot weather conditions

- i. Use cold mixing water and cool base plate if possible; store grout in cool area
 - ii. Follow manufacturer's recommendations for hot weather application
 - e. Apply to clean, sound surface
 - f. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer
2. Epoxy Grout: Apply only to clean, dry, sound surface
- a. Patching cavities in concrete including, but not limited to, tie holes, and structural and equipment support

B. APPLICATION

- 1. Non-Shrink, Non-Metallic Grout
 - a. Mix in a mechanical mixer
 - b. Use no more water than necessary to produce flowable grout
 - c. Provide air vents where necessary to eliminate air pockets
 - d. Place in accordance with manufacturer's instructions
 - e. Where exposed to view finish grout edges smooth
 - f. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound
 - g. Wet cure grout for 7 days, minimum
 - h. Maintain the temperature at a minimum of 40 deg F until grout reaches 3000 psi
 - i. After placement of grout, eliminate excessive external vibration
- 2. Epoxy Grout
 - a. Mix and place in accordance with manufacturer's instructions
 - b. Completely fill all cavities and spaces around dowels and anchors without voids
 - c. Obtain manufacturer's technical assistance as required to insure proper placement

3.12 RIPRAP

- A. Do not place riprap over frozen or spongy subgrade surfaces.
- B. Place riprap at pipe outlets and in channels as indicated on plans. Top of riprap to match invert of outlet pie and channels.
- C. Excavate and prepare subgrade.
- D. Place geotextile fabric per plans under all bedding. Place bedding and place riprap on bedding per plans.
- E. Material may be machine placed and then arranged as necessary by use of a Gradall with multi-prong grapple device or by hand to minimize voids. Dumping alone is not sufficient to achieve properly placed riprap.

3.13 FIELD QUALITY CONTROL

- A. Field inspection and testing including a lamp test will be performed for every section of pipe after backfill has occurred

1. Contractor shall furnish suitable assistance to the Engineer
 2. A minimum of 75% of a true circle will be required to indicate a properly constructed line
 3. Contractor will repair any section not passing the lamp test.
- B. Request inspection immediately after placing cover over pipe.
- C. Backfilling and testing as required per Section 31 00 00 - Earthwork.

END OF SECTION 334000

APPENDIX A

GEOTECHNICAL SUBSURFACE EXPLORATION PROGRAM

GROUND

ENGINEERING

Geotechnical Subsurface Exploration Program Loveland Sports Park Phase 2 Loveland, Colorado



Prepared For:

**City of Loveland: Parks and Recreation
500 East 3rd Street
Loveland, CO 80537**

Attn: Scott Sinn

Job Number: 17-0034

December 21st, 2017

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical evaluation performed by GROUND Engineering Consultants, Inc. (GROUND) for the City of Loveland in support of design of the proposed Loveland Sports Park: Phase 2 in Loveland, Colorado. Our study was conducted in general accordance with GROUND's Proposal No. 1710-1820, dated October 23, 2017.

A field exploration program was conducted to obtain information on the subsurface conditions. Material samples obtained during the subsurface exploration were tested in the laboratory to provide data on the engineering characteristics of the on-site soils. The results of the field exploration and laboratory testing are presented herein.

This report has been prepared to summarize the data obtained and to present our findings and conclusions based on the proposed development/improvements and the subsurface conditions encountered. Design parameters and a discussion of engineering considerations related to the proposed improvements are included herein. This report should be understood and utilized in its entirety; specific sections of the text, drawings, graphs, tables, and other information contained within this report are intended to be understood in the context of the entire report. This includes the *Closure* section of the report which outlines important limitations on the information contained herein.

This report was prepared for design purposes of the City of Loveland based on our understanding of the proposed project at the time of preparation of this report. The data, conclusions, opinions, and geotechnical parameters provided herein should not be construed to be sufficient for other purposes, including the use by contractors, or any other parties for any reason not specifically related to the design of the project. Furthermore, the information provided in this report was based on the exploration and testing methods described below. Deviations between what was reported herein and the actual surface and/or subsurface conditions may exist, and in some cases those deviations may be significant.

PROPOSED CONSTRUCTION

Provided plans show the proposed improvements including two new canopy structures, a new restroom facility, expanded parking lots at various locations throughout the

existing sports park, and an access road to serve the facility. Additionally, construction will likely also include installation of underground utilities. Building loads were unavailable at the time of this report preparation. Grading plans were not provided at the time of this report preparation. Based on our visual observation of the site, we anticipate general site grading consisting of material cuts and fills on the order of 2 feet or less may be necessary in order to facilitate proposed construction. We also assume that structural loads will be light to moderate. If proposed construction, including the assumed loading conditions, differ from those described above, or changes subsequently, GROUND should be notified to re-evaluate the parameters in this report.

SITE CONDITIONS

At the time of our exploration, the project site was the existing Loveland Sports Park. The park is located northeast of the intersection of North Boyd Lake Avenue and East County Road 20E. The site supported grass, weeds, various trees, paved parking areas, and recreation facilities. The site is bordered by North Boyd Lake to the west, E County Road 20E to the south, and agricultural fields to the east and north. The topography across the site was generally flat with a slight slope down to the east.

Fill was not recognized in our tests holes, however likely exist at the project site associated with previous development. The exact extents, limits, and composition of any man-made fill were not determined as part of the scope of work addressed by this study, and should be expected to exist at varying depths and locations across the site.

SUBSURFACE EXPLORATION

The subsurface exploration for the project was conducted on November 3rd, 2017. A total of eleven (11) test holes were drilled at the project site. Two (2) test holes were drilled within the approximate footprints of the new shelters. One (1) test hole was drilled within the approximate footprint of the new bathroom structure. The remaining eight (8) test holes were drilled within the proposed parking lot and drive lane additions. The test holes were drilled with a truck-mounted, continuous flight power auger rig to evaluate the subsurface conditions as well as to retrieve soil samples for laboratory testing and analysis. The foundation test holes were drilled to depths of approximately 26 to 31 feet below existing grades, the pavement test holes were drilled to approximately 5 to 10 feet below existing grades. A representative of GROUND directed

the subsurface exploration, logged the test holes in the field, and prepared the soil samples for transport to our laboratory.

Samples of the subsurface materials were retrieved with a 2-inch I.D. California liner sampler. The sampler was driven into the substrata with blows from a 140-pound hammer falling 30 inches. This procedure is similar to the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of soils. Depths at which the samples were obtained and associated penetration resistance values are shown on the test hole logs.

The approximate locations of the test holes are shown in Figure 1. Logs of the exploratory test holes are presented in Figures 2 to 4. Explanatory notes and a legend are provided in Figure 5.

LABORATORY TESTING

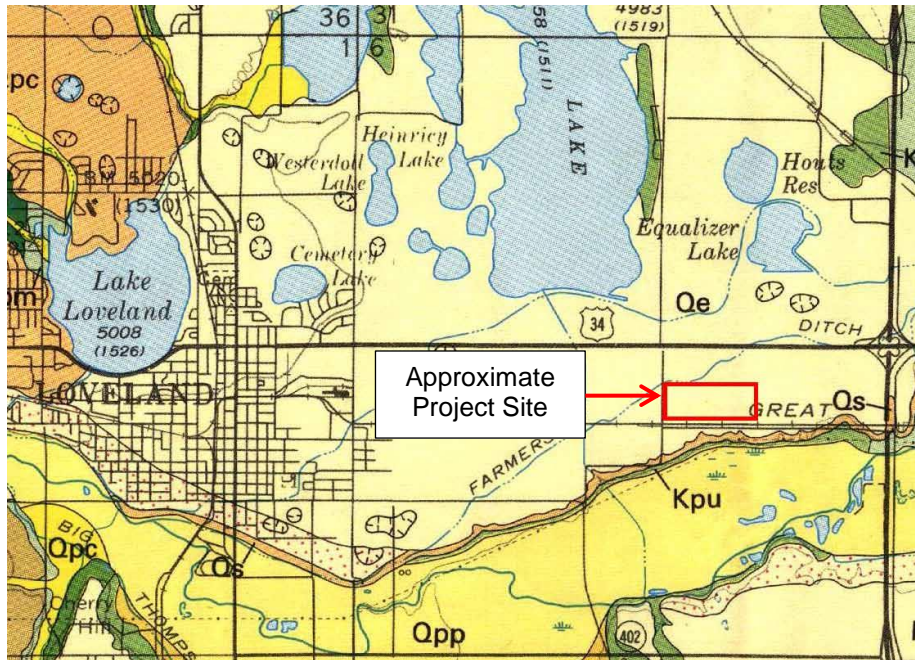
Samples retrieved from our test holes were examined and visually classified in the laboratory by the project engineer. Laboratory testing of soil samples obtained from the subject site included standard property tests, such as natural moisture contents, grain size analyses, and liquid and plastic limits. Water-soluble sulfate and corrosivity testing was completed on a selected sample of the soils as well. Laboratory tests were performed in general accordance with applicable ASTM protocols. Results of the laboratory testing program are summarized on Tables 1 and 2.

REGIONAL GEOLOGY

Regional Geology: Published maps (e.g., Colton 1978¹), depict the site as underlain by “Eolium” (**Qe**), consisting of windblown clay, silt, sand and granules light-brown to reddish-brown deposits. These windblown deposits are mapped as underlain by Pierre Shale(upper shale member) (**Kpu**). A portion of the Colton map is provided below.

¹ Colton, R.B., 1978, *Geologic map of the Boulder-Fort Collins-Greeley area, Front Range Urban Corridor, Colorado*. U.S. Geological Survey, Miscellaneous Investigations Series Map I-855-G

Loveland Sports Park: Phase 2
Loveland, Colorado



SUBSURFACE CONDITIONS

The subsurface conditions encountered in the test holes generally consisted of a thin veneer of topsoil on the order of 3 to 5 inches in thickness, underlain by sandy clay materials that generally extended to depths ranging from 19 to 24 feet below existing grades. Clayey sand was encountered below the sandy clay materials and extended to approximately 26 to 30 feet below existing grades. Claystone materials were encountered below the clayey sand and extended to the test hole termination depths of 27 and 31 feet below existing grades.

It should be noted that coarse gravel, cobbles, boulders, and similarly sized fragments of debris are not well represented in small diameter liner samples collected from 4-inch diameter test holes. Therefore, such materials may be present at varying depths at the project site.

Topsoil² was approximately three to five inches in thickness and brown.

Sandy Clay was fine to medium grained, medium to highly plastic, soft to very stiff, moist to wet, and tan to medium brown to red-brown in color with local caliche deposits.

² 'Topsoil' as used herein is defined geotechnically. The materials so described may or may not be suitable for landscaping or as a growth medium for support of such plans as may be proposed for the project.

Sand materials were clayey fine to coarse grained with gravel, low to non-plastic, loose to dense, wet, and medium brown in color.

Weathered Claystone was fine grained, medium to highly plastic, weathered, moist, and brown to gray in color.

Claystone Bedrock was fine grained, medium to highly plastic, hard to very hard, moist, and brown to gray in color with iron staining.

Swell-Consolidation Testing yielded results ranging from 0.5 percent consolidation to 2.2 percent swell at various surcharge pressures based on estimated overburden pressure.

Groundwater was encountered at depths ranging from approximately 8 to 17 feet below existing grade at the time of drilling. Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions.

SEISMIC CLASSIFICATION

According to the 2015 International Building Code® (Section 1613 Earthquake Loads), “Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7, excluding Chapter 14 and Appendix 11A. The seismic design category for a structure is permitted to be determined in accordance with Section 1613 (2015 IBC) or ASCE 7.” Exceptions to this are further noted in Section 1613.

Based on extrapolation of available data to depth and our experience in the project area, we consider the site likely to meet the criteria for a **Seismic Site Classification of D** according to the 2015 IBC classification (Section 1613.3.2). If, however, a quantitative assessment of the site seismic properties is desired, then sampling or shear wave velocity testing to a depth of 100 feet or more should be performed.

Utilizing the United States Geological Survey’s Seismic Design Maps Tool (<http://geohazards.usgs.gov/designmaps/us/application.php>), assuming a Site Class D

the project area is indicated to possess an S_{DS} value of **0.191g** and an S_{D1} value of **0.092g** for the site latitude and longitude.

FOUNDATION/FLOOR SYSTEM OVERVIEW

Geotechnical Considerations for Design: The likely bearing materials encountered at the project site area sandy clay materials. Testing indicated that swell potential of the existing materials is not a primary concern. The primary geotechnical concern for foundations placed in the areas of the subsurface explorations is the relatively soft materials encountered during our subsurface exploration.

Foundation/Floor System: According to our field and laboratory analysis, it is GROUND's opinion the materials encountered in our exploration are generally suitable to support the proposed structure on a shallow foundation system consisting of spread footings with a slab-on-grade floor system.

Footings bearing on **native, undisturbed or approved, import fill materials** may be designed for an **allowable soil bearing pressure (Q) of 1,500 psf**.

At least **12 inches** of onsite materials below the proposed slab-on-grade floor and under-slab gravel, if present, should be scarified and replaced in a properly moisture-density conditioned state in accordance with the *Project Earthworks* section of this report.

To use these parameters, the Owner must accept the risk of post-construction foundation movement associated with shallow foundation systems placed on the on-site soils. Utilizing the above parameters as well as other parameters in this report, we estimate likely post-construction foundation and floor movements to be on the order of 1 inch, with 1 inch differential movements over spans of about 40 feet. Movement estimates are difficult to predict and actual movements may be more or less

The conclusions and parameters provided in this report were based on the data presented herein, our experience in the general project area with similar structures, and our engineering judgment with regard to the applicability of the data and methods of forecasting future performance. A variety of engineering parameters were considered as indicators of potential future soil movements. Our parameters were based on our

judgment of “likely movement potentials,” (i.e., the amount of movement likely to be realized if site drainage is generally effective, estimated to a reasonable degree of engineering certainty) as well as our assumptions about the owner’s willingness to accept geotechnical risk. “Maximum possible” movement estimates necessarily will be larger than those presented herein. They also have a significantly lower likelihood of being realized in our opinion, and generally require more expensive measures to address. We encourage the Client, upon receipt of this report, to discuss these risks and the geotechnical alternatives with us.

FOUNDATION SYSTEM

The design and construction criteria presented below should be observed for a spread footing foundation system. The construction details should be considered when preparing project documents. The precautions and parameters provided below will not prevent movement of the footings if the underlying materials are subjected to alternate wetting and drying cycles. However, the recommended measures will tend to make the movement more uniform, and reduce resultant damage if such movement occurs.

Geotechnical Parameters for Shallow Foundation Design:

- 1) Footings should bear on materials as described in the *Foundation/Floor System Overview* section of this report, and may be designed for the appropriate allowable soils bearing pressure indicated.

These values may be increased by $\frac{1}{3}$ for transient loads such as wind or seismic loading.

Compression of the bearing soils for the provided allowable bearing pressure is estimated to be 1 inch, based on an assumption of drained foundation conditions. If foundation soils are subjected to an increase/fluctuation in moisture content, the effective bearing capacity will be reduced and greater post-construction movements than those estimated above may result.

- 2) To be able to use the allowable bearing capacity values presented above, strip footings should be limited to 6 feet or less in width and pad footing should have a maximum dimension of 8 feet. For other estimated settlements associated with

allowable bearing pressure values or footing widths exceeding the dimensions above please contact this office.

- 3) In order to reduce differential settlements between footings or along continuous footings, footing loads should be as uniform as possible. Differentially loaded footings will settle differentially.

Similarly, differential fill thickness beneath footings will result in increased differential settlements.

- 4) Spread footings should have a minimum lateral dimension of **18 or more inches** for linear strip footings and **24 or more inches** for isolated pad footings. Actual footing dimensions, however, should be determined by the structural engineer.
- 5) All footings should bear at an elevation **3 or more feet** below the lowest adjacent exterior finish grades.
- 6) Continuous foundation walls should be reinforced top and bottom to span an unsupported length of at least **10 feet**.
- 7) Geotechnical parameters for lateral resistance to foundation loads are provided in the *Lateral Earth Pressures* section of this report.
- 8) Connections to the building of all types must be flexible and/or adjustable to accommodate the anticipated, post-construction movements.

Shallow Foundation Construction: The following should be considered during the construction of spread footing foundations.

- 1) Care should be taken when excavating the foundations to avoid disturbing the supporting materials. Hand excavation or careful backhoe soil removal may be required in excavating the last few inches.
- 2) Footing excavation bottoms may expose loose, organic or otherwise deleterious materials, including debris. Firm materials may become disturbed by the excavation process. All such unsuitable materials should be excavated and replaced with properly compacted fill or the footing deepened.
- 3) Foundation soils may be disturbed or deform excessively under the wheel loads of heavy construction vehicles as the excavations approach footing bearing

levels. Construction equipment should be as light as possible to limit development of this condition. Track-mounted vehicles generally should be used because they exert lower contact pressures. The movement of vehicles over proposed foundation areas should be restricted.

- 4) All footing areas should be compacted with a vibratory plate compactor prior to placement of reinforcing steel placement for concrete to consolidate loose materials at the surface.
- 5) Compacted fill placed against the sides of the footings should be compacted in accordance with the criteria in the *Project Earthwork* section of this report.

FLOOR SYSTEM

The following measures are recommended to reduce damage, which may result from movement of the slab subgrade material. These measures will not eliminate potential movements. If slab-on-grade construction is used in accordance with the following criteria, as well as other applicable parameters contained in this report, we estimate that potential slab movements may be on the order of 1 inch. The actual magnitude of movement is difficult to estimate and may be more or less.

Geotechnical Parameters for Design of Slab-on-Grade Floors

- 1) Slab subgrade materials should be scarified a minimum of **12 inches** or more below slab and under slab gravel, if present. The materials should be replaced in a properly moisture-conditioned and compacted state in accordance with the parameters in the *Project Earthwork* section of this report.
- 2) An allowable subgrade vertical modulus (K) of **65 pci** may be utilized for lightly loaded slabs supported by the on-site materials. This value is for a 1-foot x 1-foot plate; they should be adjusted for slab dimension.
- 3) Floor slabs should be separated from all bearing walls and columns with slip joints, which allow unrestrained vertical movement.

Slip joints should be observed periodically, particularly during the first several years after construction. Slab movement can cause previously free-slipping

joints to bind. Measures should be taken to assure that slab isolation is maintained in order to reduce the likelihood of damage to walls and other interior improvements.

- 4) Concrete slabs-on-grade should be provided with properly designed control joints.

ACI, AASHTO and other industry groups provide guidelines for proper design and construction concrete slabs-on-grade and associated jointing. The design and construction of such joints should account for cracking as a result of shrinkage, curling, tension, loading, and curing, as well as proposed slab use. Joint layout based on the slab design may require more frequent, additional, or deeper joints, and should reflect the configuration and proposed use of the slab.

Particular attention in slab joint layout should be paid to areas where slabs consist of interior corners or curves (e.g., at column blockouts or reentrant corners) or where slabs have high length to width ratios, significant slopes, thickness transitions, high traffic loads, or other unique features. The improper placement or construction of control joints will increase the potential for slab cracking.

- 5) Interior partitions resting on floor slabs should be provided with slip joints so that if the slabs move, the movement cannot be transmitted to the upper structure. This detail is also important for wallboards and doorframes. Slip joints which will allow **2 inches or more** of differential vertical movement should be considered. It may not be practical to construct slip joints capable of accommodating movements of that magnitude. In such case, replacement of the slip joints or re-establishment of slip capacity should be anticipated and incorporated into building design. Accommodation for differential movement also should be made where partitions meet bearing walls.
- 6) Post-construction soil movements may not displace slab-on-grade floors and utility lines in the soils beneath them to the same extent. Design of floor penetrations, connections and fixtures should accommodate at least **2 inches** of differential movement.

- 7) Moisture can be introduced into a slab subgrade during construction and additional moisture will be released from the slab concrete as it cures. A properly compacted layer of free-draining gravel, 4 or more inches in thickness, should be placed beneath the slabs. This layer will help distribute floor slab loadings, ease construction, reduce capillary moisture rise, and aid in drainage.

The free-draining gravel should contain **less than 5 percent** material passing the No. 200 Sieve, **more than 50 percent retained on the No. 4 Sieve**, and a maximum particle size **of 2 inches**.

The capillary break and the drainage space provided by the gravel layer also may reduce the potential for excessive water vapor fluxes from the slab after construction as mix water is released from the concrete.

We understand, however, that professional experience and opinion differ with regard to inclusion of a free-draining gravel layer beneath slab-on-grade floors. If these issues are understood by the owner and appropriate measures are implemented to address potential concerns including slab curling and moisture fluxes, then the gravel layer may be deleted.

- 8) A vapor barrier beneath a building floor slab can be beneficial with regard to reducing exterior moisture moving into the building, through the slab, but can retard downward drainage of construction moisture. Uneven moisture release can result in slab curling. Elevated vapor fluxes can be detrimental to the adhesion and performance of many floor coverings and may exceed various flooring manufacturers' usage criteria.

Per the 2006 ACI *Location Guideline*, a vapor barrier is required under concrete floors when that floor is to receive moisture-sensitive floor covering and/or adhesives, or the room above that floor has humidity control.

Therefore, in light of the several, potentially conflicting effects of the use vapor-barriers, the owner and the architect and/or contractor should weigh the performance of the slab and appropriate flooring products in light of the intended building use, etc., during the floor system design process and the selection of

flooring materials. Use of a plastic vapor-barrier membrane may be appropriate for some building areas and not for others.

In the event a vapor barrier is utilized, it generally should consist of a minimum 15 mil thickness, extruded polyolefin plastic (no recycled content or woven materials), maintain a permeance less than 0.01 perms per ASTM E-96 or ASTM F-1249, and comply with ASTM E-1745 (Class "A"). Vapor barriers should be installed in accordance with ASTM E-1643.

Polyethylene ("poly") sheeting (even if 15 mils in thickness which polyethylene sheeting commonly is not) does not meet the ASTM E-1745 criteria and should not, in general, be used as vapor barrier material. It can be torn and/or punctured easily, does not possess necessary tensile strength, becomes brittle, tends to decompose over time, and has a relatively high permeance.

Construction Considerations for Slab-on-Grade Floors

- 9) Loose, soft or otherwise unsuitable materials exposed on the prepared surface on which the floor slab will be cast should be excavated and replaced with properly compacted fill.
- 10) Concrete floor slabs should be constructed and cured in accordance with applicable industry standards and slab design specifications.
- 11) All plumbing lines should be carefully tested before operation. Where plumbing lines enter through the floor, a positive bond break should be provided.

LATERAL EARTH PRESSURES

The at-rest, active, and passive conditions for the on-site backfill are summarized on the table below. Base friction may be combined with passive earth pressure if the foundation is in a drained condition. The values for the on-site material in the upper 10 feet provided in the table below were approximated utilizing a unit weight of 125 pcf and a phi angle of 27 degrees.

Lateral Earth Pressures (Equivalent Fluid Unit Weights)

Material Type	Water Condition	At-Rest (pcf)	Active (pcf)	Passive(pcf)	Friction Coefficient
On-Site Backfill	Drained	68	47	290(max. 2,900 psf)	0.34

The upper 1 foot of embedment should be neglected for passive resistance, however. Where this passive soil pressure is used to resist lateral loads, it should be understood that significant lateral strains will be required to mobilize the full value indicated above, likely 1 inch or more. A reduced passive pressure can be used for reduced anticipated strains, however.

The lateral earth pressures indicated above are for a horizontal upper backfill slope. The additional loading of an upward sloping backfill as well as loads from traffic, stockpiled materials, etc., should be included in the wall/shoring design. GROUND can provide the adjusted lateral earth pressures when the additional loading conditions and site grading are clearly defined.

WATER-SOLUBLE SULFATES

The concentration of water-soluble sulfates measured in a selected sample retrieved from the test holes was approximately 0.01 percent by weight (see Table 2). Such a concentration of water-soluble sulfates represents a negligible degree of sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the "Design and Control of Concrete Mixtures," published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding scale with 4 classes of severity of sulfate exposure (Class 0 to Class 3) as described in the published table below.

**REQUIREMENTS TO PROTECT AGAINST DAMAGE TO
CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE**

Severity of Sulfate Exposure	Water-Soluble Sulfate (SO₄) In Dry Soil (%)	Sulfate (SO₄) In Water (ppm)	Water Cementitious Ratio (maximum)	Cementitious Material Requirements
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Based on this datum no special sulfate-resistant cement appears necessary in project concrete.

SOIL CORROSIVITY

The degree of risk for corrosion of metals in soils commonly is considered to be in two categories: corrosion in undisturbed soils and corrosion in disturbed soils. The potential for corrosion in undisturbed soil is generally low, regardless of soil types and conditions, because it is limited by the amount of oxygen that is available to create an electrolytic cell. In disturbed soils, the potential for corrosion typically is higher, but is strongly affected by soil chemistry and other factors.

A preliminary corrosivity analysis was performed to provide a general assessment of the potential for corrosion of ferrous metals installed in contact with earth materials at the site, based on the conditions existing at the time of GROUND's evaluation. Soil chemistry and physical property data including pH, and sulfides content were obtained. Test results are summarized on Table 2.

pH Where pH is less than 4.0, soil serves as an electrolyte; the pH range of about 6.5 to 7.5 indicates soil conditions that are optimum for sulfate reduction. In the pH range above 8.5, soils are generally high in dissolved salts, yielding a low soil resistivity (AWWA, 2010). Testing indicated a pH value of approximately 8.1.

Reduction-Oxidation testing indicated a negative potential: approximately -98 millivolts. Such a low potential typically creates a more corrosive environment.

Sulfide Reactivity testing for the presence of sulfides indicated 'positive' results. The presence of sulfides in the site soils also suggests a more corrosive environment.

Soil Resistivity In order to assess the "worst case" for mitigation planning, samples of materials retrieved from the test holes were tested for resistivity in the in the laboratory, after being saturated with water, rather than in the field. Resistivity also varies inversely with temperature. Therefore, the laboratory measurements were made at a controlled temperature.

A measurement of electrical resistivity indicated a value of approximately 1,536 ohm-centimeters in a sample of the site earth materials.

Corrosivity Assessment The American Water Works Association (AWWA, 2010³) has developed a point system scale used to predict corrosivity. The scale is intended for protection of ductile iron pipe but is valuable for project steel selection. When the scale equals 10 points or higher, protective measures for ductile iron pipe are suggested. The AWWA scale (Table A.1 Soil-test Evaluation) is presented below. The soil characteristics refer to the conditions at and above pipe installation depth.

³ American Water Works Association ANSI/AWWA C105/A21.5-05 Standard.

Table A.1 Soil-test Evaluation

<u>Soil Characteristic / Value</u>	<u>Points</u>
Resistivity	
<1,500 ohm-cm	10
1,500 to 1,800 ohm-cm	8
1,800 to 2,100 ohm-cm	5
2,100 to 2,500 ohm-cm	2
2,500 to 3,000 ohm-cm	1
>3,000 ohm-cm	0
pH	
0 to 2.0	5
2.0 to 4.0	3
4.0 to 6.5	0
6.5 to 7.5	0 *
7.5 to 8.5	0
>8.5	3
Redox Potential	
< 0 (negative values)	5
0 to +50 mV	4
+50 to +100 mV	3½
> +100 mV	0
Sulfide Reactivity	
Positive	3½
Trace	2
Negative	0
Moisture	
Poor drainage, continuously wet	2
Fair drainage, generally moist	1
Good drainage, generally dry	0

* If sulfides are present and low or negative redox-potential results (< 50 mV) are obtained, add three points for this range.

We anticipate that drainage at the site after construction will be effective. Therefore, based on the values obtained for the soil parameters, the overburden soils appear to comprise a highly corrosive environment for metals (16.5 points).

If additional information is needed regarding soil corrosivity, the American Water Works Association or a Corrosion Engineer should be contacted. It should be noted, however, that changes to the site conditions during construction, such as the import of other soils,

or the intended or unintended introduction of off-site water, may significantly alter corrosion potential.

EXTERIOR FLATWORK

Proper design, drainage, construction, and maintenance of the areas between individual buildings and parking/driveway areas are critical to the satisfactory performance of the project. Sidewalks, entranceway slabs and roofs, fountains, raised planters, and other highly visible improvements commonly are installed within these zones, and distress in or near these improvements is common. Commonly, soil preparation in these areas receives little attention because they fall between the building and pavement (which are typically built with heavy equipment). Subsequent landscaping and hardscape installation often is performed by multiple sub-contractors with light or hand equipment, and over-excavation / soil processing is not performed. Therefore, particular care should be taken by the design team, contractor, and pertinent subcontractors take particular care with regard to proper subgrade preparation around the structure exteriors.

Similar to slab-on-grade floors, exterior flatwork and other hardscaping placed on the soils encountered on-site may experience post-construction movements due to volume change of the subsurface soils and the relatively light loads that they impose. Both vertical and lateral soil movements can be anticipated as the soils experience volume change as the moisture content varies. Distress to rigid hardscaping likely will result. The following measures will help to reduce damages to these improvements.

Provided the owner understands the risks identified above, the subgrade under exterior flatwork or other (non-building) site improvements should be scarified to a depth of 12 or more inches. The scarified soil should be replaced as properly moisture-conditioned and compacted fill as outlined in the *Project Earthwork* section of this report.

Prior to placement of flatwork, a proof roll should be performed to identify areas that exhibit instability and deflection. The soils in these areas should be removed and replaced with properly compacted fill or stabilized.

Flatwork should be provided with effective control joints. Increasing the frequency of joints may improve performance. ACI recommendations should be followed regarding construction and/or control joints.

In no case should exterior flatwork extend to under any portion of the building where there is less than 2 inches of vertical clearance between the flatwork and any element of the building. Exterior flatwork in contact with brick, rock facades, or any other element of the building can cause damage to the structure if the flatwork experiences movements.

GROUND does not recommend tying of exterior flatwork and/or hardscapes to the building including floor slabs, bearing walls, or columns. The exterior flatwork should be independent and be allowed to move independently from the structure and its components.

As discussed in the *Surface Drainage* section of this report, proper drainage also should be maintained after completion of the project, and re-established as necessary. In no case should water be allowed to pond on or near any of the site improvements or a reduction in performance should be anticipated.

Concrete Scaling: Climatic conditions in the project area including relatively low humidity, large temperature changes and repeated freeze – thaw cycles, make it likely that project sidewalks and other exterior concrete will experience surficial scaling or spalling. The likelihood of concrete scaling can be increased by poor workmanship during construction, such as ‘over-finishing’ the surfaces. In addition, the use of de-icing salts on exterior concrete flatwork, particularly during the first winter after construction, will increase the likelihood of scaling. Even use of de-icing salts on nearby roadways, from where vehicle traffic can transfer them to newly placed concrete, can be sufficient to induce scaling. Typical quality control / quality assurance tests that are performed during construction for concrete strength, air content, etc., do not provide information with regard to the properties and conditions that give rise to scaling.

We understand that some municipalities require removal and replacement of concrete that exhibits scaling, even if the material was within specification and placed correctly. The contractor should be aware of the local requirements and be prepared to take measures to reduce the potential for scaling and/or replace concrete that scales.

In GROUND’s experience, the measures below can be beneficial for reducing the likelihood of concrete scaling. It must be understood, however, that because of the other factors involved, including weather conditions and workmanship, surface damage to concrete can develop, even where all of these measures were followed.

- 1) Maintaining a maximum water/cement ratio of 0.45 by weight for exterior concrete mixes.
- 2) Include Type F fly ash in exterior concrete mixes as 20 percent of the cementitious material.
- 3) Specify a minimum, 28-day, compressive strength of 4,500 psi for all exterior concrete.
- 4) Include 'fibermesh' in the concrete mix. also may be beneficial for reducing surficial scaling.
- 5) Cure the concrete effectively at uniform temperature and humidity. This commonly will require fogging, blanketing and/or tenting, depending on the weather conditions. As long as 3 to 4 weeks of curing may be required, and possibly more.
- 6) Avoid placement of concrete during cold weather so that it is not exposed to freeze-thaw cycling before it is fully cured.
- 7) Avoid the use of de-icing salts on given reaches of flatwork through the first winter after construction.

We understand that commonly it may not be practical to implement some of these measures for reducing scaling due to safety considerations, project scheduling, etc. In such cases, additional costs for flatwork maintenance or reconstruction should be incorporated into project budgets.

PROJECT EARTHWORK

The earthwork criteria below are based on our interpretation of the geotechnical conditions encountered in the test holes. Where these criteria differ from applicable municipal specifications, e.g., for trench backfill compaction along a public utility line, the latter should be considered to take precedence.

General Considerations: Site grading should be performed as early as possible in the construction sequence to allow settlement of fills and surcharged ground to be realized to the greatest extent prior to subsequent construction.

Prior to earthwork construction, existing concrete, asphalt, vegetation, and other deleterious materials should be removed and disposed of off-site. Relic underground utilities should be abandoned in accordance with applicable regulations, removed as necessary, and properly capped.

Topsoil present on-site should not be incorporated into ordinary fills. Instead, topsoil should be stockpiled during initial grading operations for placement in areas to be landscaped or for other approved uses.

Use of Existing Native Soils: Overburden soils that are free of trash, organic material (including all firewood, wood chips, etc.), construction debris, and other deleterious materials are suitable, in general, for placement as compacted fill. Organic materials should not be incorporated into project fills.

Fragments of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. In general, such materials should be placed as deeply as possible in the project fills. A Geotechnical Engineer should be consulted regarding appropriate direction for usage of such materials on a case-by-case basis when such materials have been identified during earthwork. Standard parameters that likely will be generally applicable can be found in Section 203 of the current CDOT Standard Specifications for Road and Bridge Construction.

Imported Fill Materials: If it is necessary to import material to the site, the imported soils should be free of organic material, and other deleterious materials. **Imported material should consist of soils that have less than 50 percent passing the No. 200 Sieve and should have a plasticity index of less than 15.** Representative samples of the materials proposed for import should be tested and approved prior to transport to the site.

Fill Platform Preparation: Prior to filling, the top 8 to 12 inches of in-place materials on which fill soils will be placed should be scarified, moisture conditioned and properly

compacted in accordance with the parameters below to provide a uniform base for fill placement. *If over-excavation is to be performed, then these parameters for subgrade preparation are for the subgrade **below the bottom** of the specified over-excavation depth.*

If surfaces to receive fill expose loose, wet, soft or otherwise deleterious material, additional material should be excavated, or other measures taken to establish a firm platform for filling. The surfaces to receive fill must be effectively stable prior to placement of fill.

General Considerations for Fill Placement: Fill soils should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted. No fill materials should be placed, worked, rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Where soils supporting foundations or on which foundation will be placed are exposed to freezing temperatures or repeated freeze – thaw cycling during construction – commonly due to water ponding in foundation excavations – bearing capacity typically is reduced and/or settlements increased due to the loss of density in the supporting soils. After periods of freezing conditions, the contractor should re-work areas affected by the formation of ice to re-establish adequate bearing support.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. Materials that are not properly moisture conditioned may exhibit pumping, rutting, and deflection at high moisture contents.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the specified ranges are obtained.

Compaction Specifications: Soils that classify as GP, GW, GM, GC, SP, SW, SM, or SC in accordance with the USCS classification system (granular materials) should be compacted to 95 or more percent of the maximum modified Proctor dry density at moisture contents within 2 percent of optimum moisture content as determined by ASTM D1557.

Soils that classify as ML or CL should be compacted to 95 percent or more of the maximum standard Proctor density at moisture contents from 1 percent below to 3 percent above the optimum moisture content as determined by ASTM D698.

Use of Squeegee: Relatively uniformly graded fine gravel or coarse sand, i.e., “squeegee,” or similar materials commonly are proposed for backfilling foundation excavations, utility trenches (excluding approved pipe bedding), and other areas where employing compaction equipment is difficult. In general, GROUND does not recommend this procedure for the following reasons:

Although commonly considered “self compacting,” uniformly graded granular materials require densification after placement, typically by vibration. The equipment to densify these materials is not available on many job-sites.

Even when properly densified, uniformly graded granular materials are permeable and allow water to reach and collect in the lower portions of the excavations backfilled with those materials. This leads to wetting of the underlying soils and resultant potential loss of bearing support as well as increased local heave or settlement.

It is GROUND’s opinion that wherever possible, excavations be backfilled with approved, on-site soils placed as properly compacted fill. Where this is not feasible, use of “Controlled Low Strength Material” (CLSM), i.e., a lean, sand-cement slurry (“flowable fill”) or a similar material for backfilling should be considered.

Where “squeegee” or similar materials are proposed for use by the contractor, the design team should be notified by means of a Request for Information (RFI), so that the proposed use can be considered on a case-by-case basis. Where “squeegee” meets the project requirements for pipe bedding material, however, it is acceptable for that use.

Settlements: Settlements will occur in filled ground, typically on the order of 1 to 2 percent of the fill depth. If fill placement is performed properly and is tightly controlled, in GROUND’s experience the majority (on the order of 60 to 80 percent) of that settlement will typically take place during earthwork construction, provided the contractor achieves the compaction levels recommended herein. The remaining potential settlements likely will take several months or longer to be realized, and may be exacerbated if these fills

are subjected to changes in moisture content. GROUND anticipates some degree of post-construction movement/distress as a result of settlement.

Cut and Filled Slopes: Permanent site slopes supported by on-site soils up to 5 feet in height may be constructed no steeper than 3 : 1 (horizontal : vertical) in site soils. Minor raveling or surficial sloughing should be anticipated on slopes cut at this angle until vegetation is well re-established. Surface drainage should be designed to direct water away from slope faces.

Steeper slope angles and heights may be possible but will require detailed slope stability analysis based on final proposed grading plans. GROUND should be retained to evaluate this on a case by case basis, if needed.

EXCAVATION CONSIDERATIONS

Excavation Difficulty: Test holes for the subsurface exploration were advanced to the depths indicated on the test hole logs by means of conventional, truck-mounted, geotechnical drilling equipment. We anticipate no significant excavation difficulties in the majority of the site with conventional heavy-duty excavation equipment in good working condition.

Excavation Slopes: Temporary, un-shored excavation slopes up to 10 feet in height be cut no steeper than 1 (H) to 1 (V) in the on-site soils in the absence of seepage. Some surface sloughing may occur on the slope faces at these angles. Where seepage or flowing groundwater is encountered in shallow project excavations, a Geotechnical Engineer should be retained to evaluate the conditions and provided additional direction, as appropriate. The risk of slope instability will be significantly increased in areas of seepage along excavation slopes.

Should site constraints prohibit the use of the recommended slope angles, temporary shoring should be used. The shoring should be designed to resist the lateral earth pressure exerted by structure, traffic, equipment, and stockpiles. GROUND can be retained to provide shoring design upon request.

Any excavations in which personnel will be working must comply with all OSHA Standards and Regulations (CFR 29 Part 1926). The contractor's "responsible person"

should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. GROUND has provided the information above solely as a service to the client, and is not assuming responsibility for construction site safety or the contractor's activities.

Surface Water and Groundwater: Good surface drainage should be provided around temporary excavation slopes to direct surface runoff away from the slope faces. A properly designed swale should be provided at the top of the excavations. In no case should water be allowed to pond at the site. Slopes should be protected against erosion. Erosion along the slopes will result in sloughing and could lead to a slope failure.

Groundwater was measured as shallow as 8 feet in the test holes. Groundwater is not anticipated to be a significant factor for shallow earthworks during construction of this project. If seepage or groundwater is encountered in shallow project excavations, the Geotechnical Engineer should be retained to evaluate the conditions and provided additional parameters, as appropriate.

UTILITY LATERAL INSTALLATION AND BACKFILLING

The measures and criteria below are based on GROUND's evaluation of the local, geotechnical conditions. Where the parameters herein differ from applicable municipal requirements, the latter should be considered to govern.

Pipe Support: The bearing capacity of the site soils appeared adequate, in general, for support of buried utilities. The pipes + contents, typically, are less dense than the soils which will be displaced for installation. Therefore, GROUND anticipates no significant pipe settlements in these materials where properly bedded.

Excavation bottoms may expose soft, loose or otherwise deleterious materials, including debris. Firm materials may be disturbed by the excavation process. All such unsuitable materials should be excavated and replaced with properly compacted fill. Areas allowed to pond water will require excavation and replacement with properly compacted fill. The contractor should take particular care to ensure adequate support near pipe joints which are less tolerant of extensional strains.

Where thrust blocks are needed, they may be designed utilizing the parameters set forth in the *Later Earth Pressures* section of this report

Trench Backfilling: Some settlement of compacted soil trench backfill materials should be anticipated, even where all the backfill is placed and compacted correctly. Typical settlements are on the order of 1 to 2 percent of fill thickness. However, the need to compact to the lowest portion of the backfill must be balanced against the need to protect the pipe from damage from the compaction process. Some thickness of backfill may need to be placed at compaction levels lower than recommended or specified (or smaller compaction equipment used together with thinner lifts) to avoid damaging the pipe. Protecting the pipe in this manner can result in somewhat greater surface settlements. Therefore, although other alternatives may be available, the following options are presented for consideration:

Controlled Low Strength Material: Because of these limitations, we recommend backfilling the entire depth of the trench (both bedding and common backfill zones) with “controlled low strength material” (CLSM), i.e., a lean, sand-cement slurry, “flowable fill,” or similar material along all trench alignment reaches with low tolerances for surface settlements.

We recommend that CLSM used as pipe bedding and trench backfill exhibit a 28-day unconfined compressive strength between 50 to 150 psi so that re-excavation is not unusually difficult.

Placement of the CLSM in several lifts or other measures likely will be necessary to avoid ‘floating’ the pipe. Measures also should be taken to maintain pipe alignment during CLSM placement.

Compacted Soil Backfilling: Where compacted soil backfilling is employed, using the site soils or similar materials as backfill, the risk of backfill settlements entailed in the selection of this higher risk alternative must be anticipated and accepted by the Client/Owner.

We anticipate that the on-site soils excavated from trenches will be suitable, in general, for use as common trench backfill within the above-described limitations. Backfill soils should be free of vegetation, organic debris and other deleterious materials. Fragments

of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) coarser than 3 inches in maximum dimension should not be incorporated into trench backfills.

If it is necessary to import material for use as backfill, the imported soils should meet the requirements set for in the *Project Earthwork* section of this report. Representative samples of the materials proposed for import should be tested and approved prior to transport to the site.

Soils placed for compaction as trench backfill should be conditioned to a relatively uniform moisture content, placed and compacted in accordance with the parameters in the *Project Earthwork* section of this report.

Pipe Bedding: Pipe bedding materials, placement and compaction should meet the specifications of the pipe manufacturer and applicable municipal standards. Bedding should be brought up uniformly on both sides of the pipe to reduce differential loadings.

As discussed above, we recommend the use of CLSM or similar material in lieu of granular bedding and compacted soil backfill where the tolerance for surface settlement is low. (Placement of CLSM as bedding to at least 12 inches above the pipe can protect the pipe and assist construction of a well-compacted conventional backfill, although possibly at an increased cost relative to the use of conventional bedding.)

If a granular bedding material is specified, GROUND recommends that with regard to potential migration of fines into the pipe bedding, design and installation follow ASTM D2321. If the granular bedding does not meet filter criteria for the enclosing soils, then non-woven filter fabric (e.g., Mirafi® 140N, or the equivalent) should be placed around the bedding to reduce migration of fines into the bedding which can result in severe, local surface settlements. Where this protection is not provided, settlements can develop/continue several months or years after completion of the project. In addition, clay or concrete cut-off walls should be installed to interrupt the granular bedding section to reduce the rates and volumes of water transmitted along the utility alignment which can contribute to migration of fines.

If granular bedding is specified, the contractor should not anticipate that significant volumes of on-site soils may be suitable for that use. Materials proposed for use as pipe

bedding should be tested for suitability prior to use. Imported materials should be tested and approved prior to transport to the site.

SURFACE DRAINAGE

The site soils are relatively stable with regard to moisture content – volume relationships at their existing moisture contents. Other than the anticipated, post-placement settlement of fills, post-construction soil movements will result primarily from the introduction of water into the soils underlying the proposed structure, hardscaping and pavements. Based on the site surface and subsurface conditions encountered in this study, we do not anticipate a rise in the local water table sufficient to approach grade beam or floor elevations. Therefore, wetting of the soils likely will result from infiltrating surface waters (precipitation, irrigation, etc.), and water flowing along constructed pathways such as bedding in utility pipe trenches.

The following drainage measures should be followed both for during construction and as part of project design. The facility should be observed periodically to evaluate the surface drainage and identify areas where drainage is ineffective. Routine maintenance of site drainage should undertaken throughout the design life of the proposed facility. If these measures are not implemented and maintained effectively, the movement estimates provided in this report could be exceeded.

- 1) Wetting or drying of the underslab areas should be avoided during and after construction. Permitting increases/variations in moisture to the adjacent or supporting soils may result in increased total and/or differential movements.
- 2) Positive surface drainage measures should be provided and maintained to reduce water infiltration into foundation soils.

The ground surface surrounding the exterior of each building should be sloped to drain away from the foundation in all directions. A minimum slope of 12 inches in the first 10 feet should be constructed in the areas not covered with pavement or concrete slabs, or a minimum of 3 percent in the first 10 feet in the areas covered with pavement or concrete slabs. Reducing the slopes to comply with ADA requirements or other reasons may be necessary but may result in an increased

potential for moisture infiltration and subsequent volume change of the underling soils.

In no case should water be allowed to pond near or adjacent to foundation elements, hardscaping, etc.

- 3) Drainage also should be established to direct water away from sidewalks and other hardscaping as well as utility trench alignments which are not tolerant of moisture-volume changes in the underlying soils or flow of infiltrating water.

The ground surface near foundation elements should be able to convey water away readily. Cobbles or other materials that tend to act as baffles and restrict surface flow should not be used to cover the ground surface near the foundations.

Where the ground surface does not convey water away readily, additional post-construction movements and distress should be anticipated.

- 4) In GROUND's experience, it is common during construction that in areas of partially completed paving or hardscaping, bare soil behind curbs and gutters, and utility trenches, water is allowed to pond after rain or snow-melt events. Wetting of the subgrade can result in loss of subgrade support and increased settlements / increase heave. By the time final grading has been completed, significant volumes of water can already have entered the subgrade, leading to subsequent distress and failures. The contractor should maintain effective site drainage throughout construction so that water is directed into appropriate drainage structures.

In no case should water be permitted to pond adjacent to or on sidewalks, hardscaping, or other improvements as well as utility trench alignments, which are likely to be adversely affected by moisture-volume changes in the underlying soils or flow of infiltrating water.

- 5) Roof downspouts and drains, if used, should discharge well beyond the perimeter of the structure foundation, or be provided with positive conveyance off-site for collected waters.

If roof downspouts and drains are not used, then surface drainage design should anticipate concentrated volumes of water adjacent to the buildings.

- 6) Irrigation water – both that applied to landscaped areas and over-spray – commonly is a significant cause of distress to improvements. Where (near-) saturated soil conditions are sustained, distress to nearby improvements should be anticipated.

To reduce to potential for such distress, vegetation requiring watering should be located 10 or more feet from the building perimeter, flatwork, or other improvements. Irrigation sprinkler heads should be deployed so that applied water is not introduced near or into foundation/subgrade soils. Landscape irrigation should be limited to the minimum quantities necessary to sustain healthy plant growth.

Use of drip irrigation systems can be beneficial for reducing over-spray beyond planters. Drip irrigation also can be beneficial for reducing the amounts of water introduced to building foundation soils, but only if the total volumes of applied water are controlled with regard to limiting that introduction. Controlling rates of moisture increase beneath the foundations, floors and other improvements should take higher priority than minimizing landscape plant losses.

Where plantings are desired within 10 feet of the building, plants should be placed in water-tight planters, constructed either in-ground or above-grade, to reduce moisture infiltration in the surrounding subgrade soils. Planters should be provided with positive drainage and landscape underdrains.

As an alternative involving only a limited increase in risk, the use of water-tight planters may be replaced by local shallow underdrains beneath the planter beds.

- 7) Plastic membranes should not be used to cover the ground surface near the building without careful consideration of other components of project drainage. Plastic membranes can be beneficial to directing surface waters away from the building and toward drainage structures. However, they effectively preclude evaporation and transpiration of shallow soil moisture. Therefore, soil moisture

tends to increase beneath a continuous membrane. Where plastic membranes are used, additional shallow, subsurface drains should be installed.

Perforated “weed barrier” membranes that allow ready evaporation from the underlying soils may be used.

PAVEMENT SECTIONS

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. The standard care of practice in pavement design describes the flexible pavement section as a “20-year” design pavement: however, most flexible pavements will not remain in satisfactory condition without routine maintenance and rehabilitation procedures performed throughout the life of the pavement. Pavement designs for the private pavements were developed in general accordance with the design guidelines and procedures of the American Association of State Highway and Transportation Officials (AASHTO).

Subgrade Materials Based on the results of our field exploration and laboratory testing, the majority of potential pavement subgrade materials classify as A-6 to A-4 soil in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system.

Based on our experience at similar sites, an R-Value of 5 was estimated for the likely on-site pavement subgrade materials. An R-Value of 5 converts to a resilient modulus of 3,052 psi based on CDOT correlation tables. It is important to note that significant decreases in soil support have been observed as the moisture content increases above the optimum. Pavements that are not properly drained may experience a loss of the soil support and subsequent reduction in pavement life.

Anticipated Traffic Based on our experience with similar projects an equivalent 18-kip daily load application (EDLA) value of 5 was assumed for the general parking areas, an EDLA value of 10 was assumed for the new access roadway. The EDLA values of 5 and 10 were converted to equivalent 18-kip single axle load (ESAL) values of 36,500 and 73,000 respectively for a 20-year design life. If anticipated traffic loadings differ

significantly from these assumed values, GROUND should be notified to re-evaluate the pavement recommendations below.

Pavement Sections The soil resilient modulus and the ESAL values were used to determine the required design structural number for the project pavements. The required structural number was then used to develop the pavement sections. Pavement designs were based on the DARWin™ computer program that solves the 1993 AASHTO pavement design equations. A Reliability Level of 75 percent was utilized to develop the pavement sections, together with a Serviceability index loss of 2.0. An overall standard of deviation of 0.44 also was used. Structural coefficients of 0.44 was used for hot bituminous asphalt and 0.11 for aggregate base course, respectively. The resultant minimum pavement sections that should be used at the facility are tabulated below.

Minimum Pavement Sections

Location	Full Depth Asphalt	Composite Section
	<i>(inches Asphalt)</i>	<i>(inches Asphalt / inches ABC)</i>
New Access Road	6.5	4.5 / 8
General Parking	6.0	4.0 / 8

Heavy traffic areas/routes serving the facility that impose high stress on the pavement such as trash collection areas should be provided with rigid pavements consisting of **6.5 or more inches of portland cement concrete underlain by 6 or more inches of properly compacted CDOT Class 5 or 6 Aggregate Base Course**. (An equivalent composite flexible section for these areas would not perform as well as the concrete section where heavy vehicles are parked, stop suddenly, turn repeatedly, etc.)

Pavement Materials Asphalt pavement should consist of a bituminous plant mix composed of a mixture of aggregate and bituminous material. Asphalt mixture(s) should meet the requirements of a job-mix formula established by a qualified engineer and applicable local municipality design requirements.

Aggregate base material should meet the criteria of CDOT Class 5 or 6 Aggregate Base Course. Base course should be placed in and compacted in accordance with the standards in the *Project Earthwork* section of this report.

Concrete pavements should consist of a plant mix composed of a mixture of aggregate, Portland cement and appropriate admixtures meeting the requirements of a job-mix formula established by a qualified engineer and applicable local municipality design requirements. Concrete should have a minimum modulus of rupture of third point loading of 650 psi. Normally, concrete with a 28-day compressive strength of 4,500 psi should develop this modulus of rupture value. The concrete should be air-entrained with approximately 6 percent air and should have a minimum cement content of 6 sacks per cubic yard. Maximum allowable slump should be 4 inches for hand-placed concrete. Machine-placed concrete may require a lower slump.

These concrete mix design criteria should be coordinated with other project requirements including any criteria for sulfate resistance presented in the *Water-Soluble Sulfates* section of this report. To reduce surficial spalling resulting from freeze-thaw cycling, we suggest that pavement concrete meet the requirements of CDOT Class P concrete. In addition, the use of de-icing salts on concrete pavements during the first winter after construction will increase the likelihood of the development of scaling. Placement of flatwork concrete during cold weather so that it is exposed to freeze-thaw cycling before it is fully cured also increases its vulnerability to scaling. Concrete placing during cold weather conditions should be blanketed or tented to aid in curing.

Concrete pavements should contain sawed or formed joints. CDOT and various industry groups provide guidelines for proper design and concrete construction and associated jointing. In areas of repeated turning stresses the concrete pavement joints should be fully tied and doweled. Example layouts for joints, as well as ties and dowels, that may be applicable can be found in CDOT's M standards, found at the CDOT website: <http://www.dot.state.co.us/DesignSupport/>. PCA, ACI and ACPA publications also provide useful guidance in these regards.

Subgrade Preparation Shortly before paving, the pavement subgrade should be excavated and/or scarified to a minimum depth of **12 inches**, moisture-conditioned and properly re-compacted.

Subgrade preparation should extend the full width of the pavement from back-of-curb to back-of-curb. The subgrade for sidewalks and other project hardscaping also should be prepared in the same manner.

Criteria and standards for fill placement and compaction are provided in the *Project Earthwork* section of this report. The contractor should be prepared either to dry the subgrade materials or moisten them, as needed, prior to compaction. Localized stabilization efforts such as chemical stabilization or removal and replacement with aggregate base may be used in areas that do not stabilize with conventional moisture-density treatments.

Where adequate drainage cannot be achieved or maintained, excavation and replacement should be undertaken to a greater depth, in addition to the edge drains discussed below.

Proof Rolling Immediately prior to paving, the subgrade should be proof rolled with a heavily loaded, pneumatic tired vehicle. Areas that show excessive deflection during proof rolling should be excavated and replaced and/or stabilized. Areas allowed to pond prior to paving will require significant re-working prior to proof-rolling. Establishment of a firm paving platform (as indicated by proof rolling) is an additional requirement beyond proper fill placement and compaction. It is possible for soils to be compacted within the limits recommended in the *Project Earthwork* section of this report and fail proof rolling, particularly in the upper range of indicated moisture contents.

Additional Considerations The collection and diversion of surface drainage away from paved areas is extremely important to satisfactory performance of the pavements. The subsurface and surface drainage systems should be carefully designed to ensure removal of the water from paved areas and subgrade soils. Allowing surface waters to pond on pavements will cause premature pavement deterioration. Where topography, site constraints or other factors limit or preclude adequate surface drainage, pavements should be provided with edge drains to reduce loss of subgrade support. The long-term performance of the pavement also can be improved greatly by proper backfilling and compaction behind curbs, gutters, and sidewalks so that ponding is not permitted and water infiltration is reduced.

Landscape irrigation in planters adjacent to pavements and in “island” planters within paved areas should be carefully controlled or differential heave and/or rutting of the nearby pavements will result. Drip irrigation systems are recommended for such planters to reduce over-spray and water infiltration beyond the planters. Enclosing the

soil in the planters with plastic liners and providing them with positive drainage also will reduce differential moisture increases in the surrounding subgrade soils.

In our experience, infiltration from planters adjacent to pavements is a principal source of moisture increase beneath those pavements. This wetting of the subgrade soils from infiltrating irrigation commonly leads to loss of subgrade support for the pavement with resultant accelerating distress, loss of pavement life and increased maintenance costs. This is particularly the case in the later stages of project construction after landscaping has been emplaced but heavy construction traffic has not ended. Heavy vehicle traffic over wetted subgrade commonly results in rutting and pushing of flexible pavements, and cracking of rigid pavements. Where the subgrade soils are expansive, wetting also typically results in increased pavement heave. In relatively flat areas where design drainage gradients necessarily are small, subgrade settlement or heave can obstruct proper drainage and yield increased infiltration, exaggerated distress, etc. (These considerations apply to project flatwork, as well.)

Also, GROUND's experience indicates that longitudinal cracking is common in asphalt-pavements generally parallel to the interface between the asphalt and concrete structures such as curbs, gutters or drain pans. This of this type is likely to occur even where the subgrade has been prepared properly and the asphalt has been compacted properly.

The anticipated traffic loading does not include excess loading conditions imposed by heavy construction vehicles. Consequently, heavily loaded concrete, lumber, and building material trucks can have a detrimental effect on the pavement. GROUND recommends that an effective program of regular maintenance be developed and implemented to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavements.

Most pavements will not remain in satisfactory condition and achieve their "design lives" without regular maintenance and rehabilitation procedures performed throughout the life of the pavement. Maintenance and rehabilitation measures preserve, rather than improve, the structural capacity of the pavement structure. Therefore, GROUND recommends that an effective program of regular maintenance be developed and implemented to seal cracks, repair distressed areas, and perform thin overlays

throughout the lives of the pavements. The greatest benefit of pavement overlaying will be achieved by overlaying sound pavements that exhibit little or no distress.

Crack sealing should be performed at least annually and a fog seal/chip seal program should be performed on the pavements every 3 to 4 years. After approximately 8 to 10 years after construction, patching, additional crack sealing, and asphalt overlay may be required. Prior to overlays, it is important that all cracks be sealed with a flexible, rubberized crack sealant in order to reduce the potential for propagation of the crack through the overlay. If actual traffic loadings exceed the values used for development of the pavement sections, however, pavement maintenance measures will be needed on an accelerated schedule.

CLOSURE AND LIMITATIONS

Geotechnical Review The author of this report or a GROUND principal should be retained to review project plans and specifications to evaluate whether they comply with the intent of the measures discussed in this report. The review should be requested in writing.

The geotechnical conclusions and parameters presented in this report are contingent upon observation and testing of project earthwork by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the parameters in this report, or by providing alternative parameters.

Materials Testing The City of Loveland should consider retaining a geotechnical engineer to perform materials testing during construction. The performance of such testing or lack thereof, however, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of his work; furthermore, testing by the geotechnical engineer does not preclude the contractor from obtaining or providing whatever services that he deems necessary to complete the project in accordance with applicable documents.

Limitations This report has been prepared for the City of Loveland as it pertains to design of the proposed *Loveland Sports Park: Phase 2* as described herein. It should not be assumed to contain sufficient information for other parties or other purposes. The Client has agreed to the terms, conditions, and liability limitations outlined in our proposal between the City of Loveland and GROUND. Reliance upon our report is not granted to any other potential owner, contractor, or lender. Requests for third-party reliance should be directed to GROUND in writing; granting reliance by GROUND is not guaranteed.

In addition, GROUND has assumed that project construction will commence by Spring/Summer 2018. Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical conclusions in this report may be re-evaluated and, as necessary, modified.

The geotechnical conclusions in this report were based on subsurface information from a limited number of exploration points, as shown in Figure 1, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration. In addition, a contractor who obtains information from this report for development of his scope of work or cost estimates does so solely at his own risk and may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor should obtain the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes, but is not limited to, information regarding excavation conditions, earth material usage, current depths to groundwater, etc. Because of the necessarily limited nature of the subsurface exploration performed for this study, the contractor should be allowed to evaluate the site using test pits or other means to obtain additional subsurface information to prepare his bid.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, a geotechnical engineer should be retained at

once, so that our conclusions for this site may be re-evaluated in a timely manner and dependent aspects of project design can be modified, as necessary.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed structure and pavement will depend on implementation of the conclusions and information in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by the City of Loveland

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this report, as well as the estimated performance (and limitations with any such estimations) of proposed improvements are understood by the City of Loveland. Utilizing the geotechnical parameters and measures herein for planning, design, and/or construction constitutes understanding and acceptance of the conclusions with regard to risk and other information provided herein, associated improvement performance, as well as the limitations inherent within such estimates. Ensuring correct interpretation of the contents of this report by others is not the responsibility of GROUND. If any information referred to herein is not well understood, it is imperative that the City of Loveland contact the author or a GROUND principal immediately. We will be available to meet to discuss the risks and remedial approaches presented in this report, as well as other potential approaches, upon request.

This report was prepared in accordance with generally accepted soil and foundation engineering practice in the project area at the date of preparation. Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity.

GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or conclusions contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect.

**Loveland Sports Park: Phase 2
Loveland, Colorado**

This document, together with the concepts and conclusions presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Re-use of, or improper reliance on this document without written authorization and adaption by GROUND Engineering Consultants, Inc., shall be without liability to GROUND Engineering Consultants, Inc.

GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide the City of Loveland with a proposal for construction observation and materials testing.

Sincerely,
GROUND Engineering Consultants, Inc.

Kelsey Van Bommel, P.E.

Reviewed by Joseph Zorack, P.E.



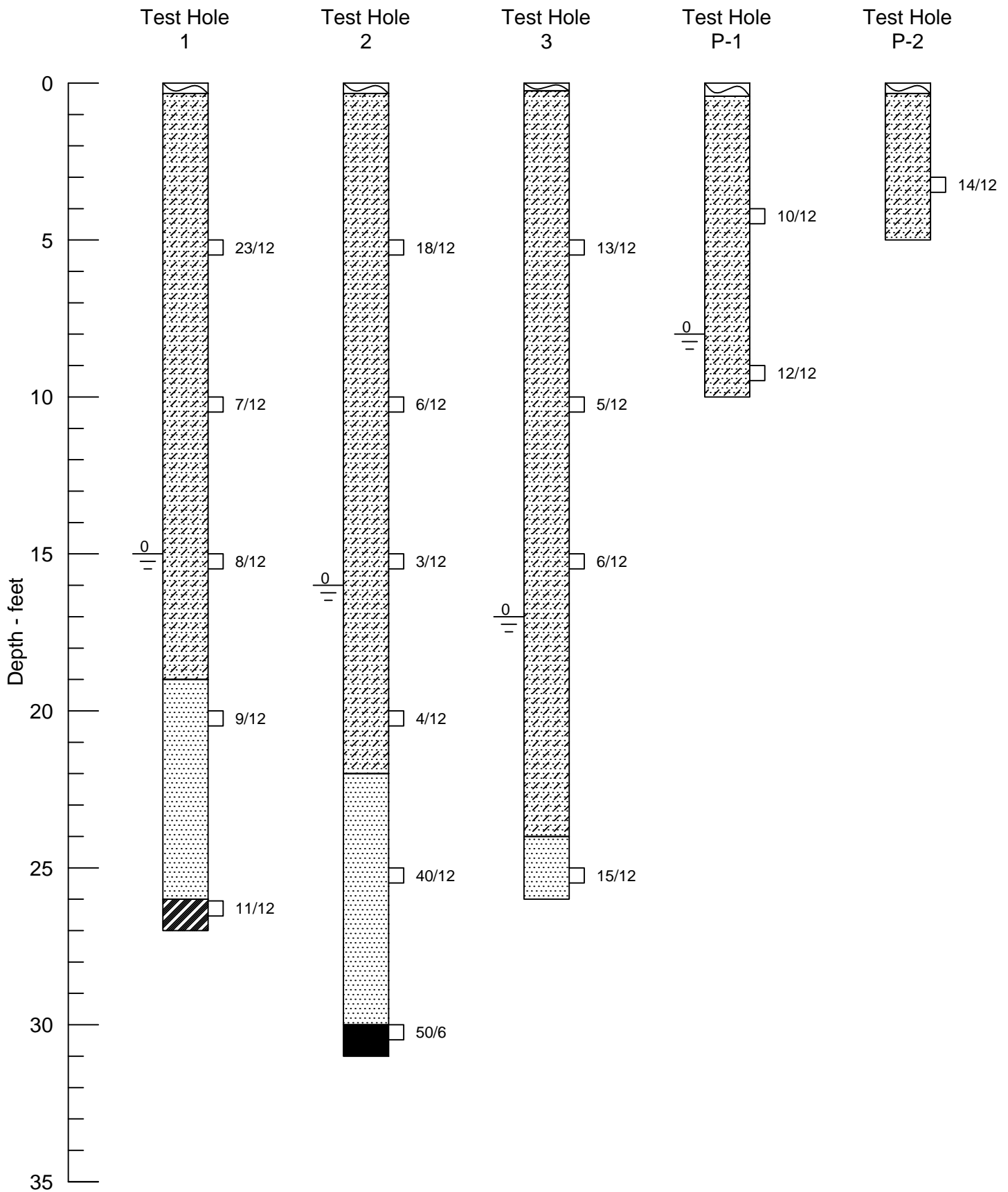


GOOGLE EARTH AERIAL IMAGE (09/07/2016)

1
⊕ Indicates test hole number and approximate location.

⬆
⊕
⬆
(Not to Scale)

GROUND ENGINEERING CONSULTANTS	
LOCATION OF TEST HOLES	
JOB NO.: 17-0034	FIGURE: 1
CADFILE NAME: 0034SITE.DWG	



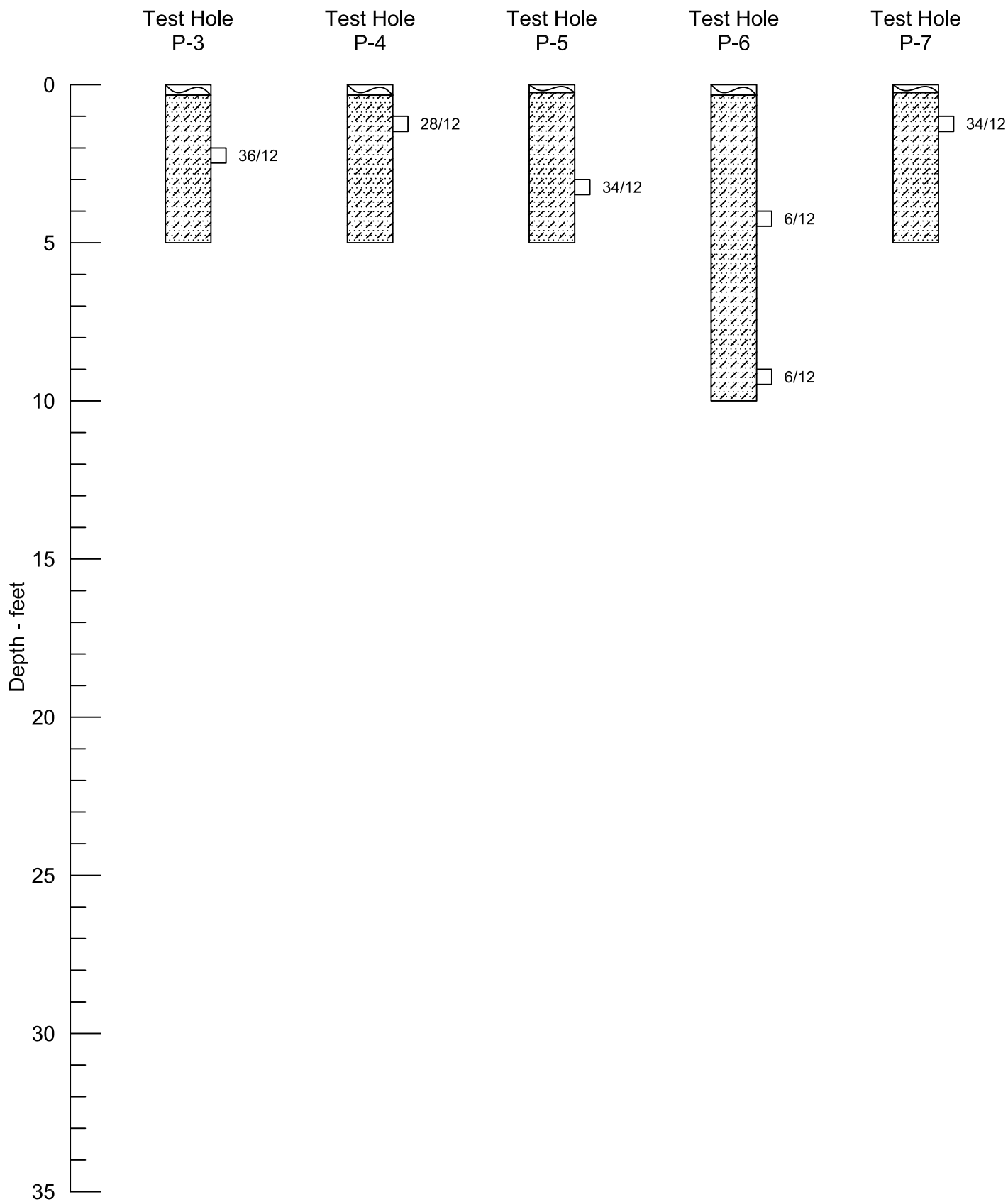
GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 17-0034

FIGURE: 2

CADFILE NAME: 0034LOG01.DWG



GROUND
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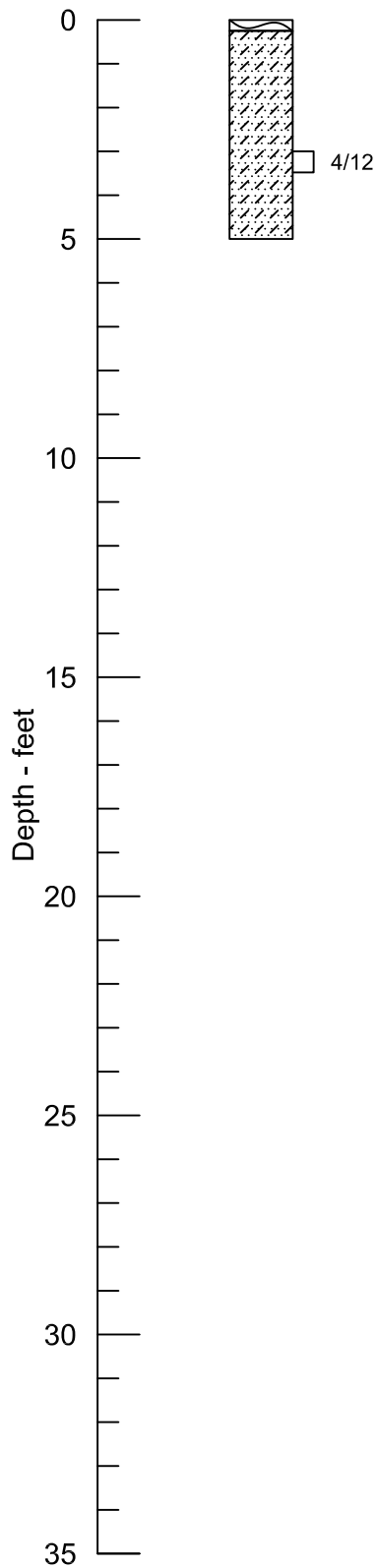
LOGS OF TEST HOLES

JOB NO.: 17-0034

FIGURE: 3

CADFILE NAME: 0034LOG02.DWG

Test Hole
P-8



GROUND
ENGINEERING CONSULTANTS

LOGS OF TEST HOLES

JOB NO.: 17-0034

FIGURE: 4

CADFILE NAME: 0034LOG03.DWG

LEGEND:



Topsoil



Sand and Clay: Fine to medium grained, medium to highly plastic, soft to very stiff, moist to wet, and tan to medium brown to red-brown in color with local caliche deposits.



Sand: Clayey fine to coarse grained with gravel, low to non-plastic, loose to dense, wet, and medium brown in color.



Weathered Claystone: Fine grained, medium to highly plastic, weathered, moist, and brown to gray in color.



Claystone Bedrock: Fine grained, medium to highly plastic, hard to very hard, moist, and brown to gray in color with iron staining.



Drive sample, 2-inch I.D. California liner sample

23/12

Drive sample blow count, indicates 23 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

0



Depth to water level and number of days after drilling that measurement was taken.

NOTES:

- 1) Test holes were drilled on 11/03/2017 with 4-inch diameter continuous flight augers.
- 2) Locations of the test holes were measured approximately by pacing from features shown on the site plan provided.
- 3) Elevations of the test holes were not measured and the logs of the test holes are drawn to depth.
- 4) The test hole locations and elevations should be considered accurate only to the degree implied by the method used.
- 5) The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.
- 6) Groundwater level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.
- 7) The material descriptions on this legend are for general classification purposes only. See the full text of this report for descriptions of the site materials and related information.
- 8) All test holes were immediately backfilled upon completion of drilling, unless otherwise specified in this report.

GROUND
ENGINEERING CONSULTANTS

LEGEND AND NOTES

JOB NO.: 17-0034

FIGURE: 5

CADFILE NAME: 0034LEG.DWG

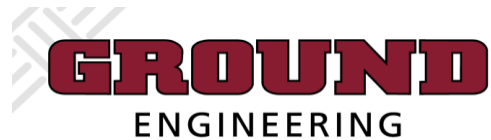


TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits		Percent Swell (Surcharge Pressure)	USCS Classifi- cation	AASHTO Classifi- cation (GI)	Soil or Bedrock Type
Test Hole No.	Depth (feet)				Liquid Limit	Plasticity Index				
TH-1	5	19.3	108.2	84	41	21	-1.1(500 psf)	(CL)s	A-7-6(158)	Sandy Clay
TH-2	5	21.3	105.2	59	32	17		s(CL)	A-6(7)	Sandy Clay
TH-2	10	16.2	102.9	64	32	15	-0.5 (1000 psf)	s(CL)	A-6(7)	Sandy Clay
TH-3	5	17.6	106.1	85	37	19	-0.5 (500 psf)	(CL)s	A-6(16)	Clay with Sand
P-1	4	17.1	104.4	89	38	20		(CL)	A-6(17)	Slightly Sandy Clay
P-2	3	21.0	102.8	91	39	19	-0.4 (200 psf)	(CL)	A-6(18)	Slightly Sandy Clay
P-3	2	10.2	111.3	84	38	20	0.1 (200 psf)	(CL)s	A-6(16)	Clay with Sand
P-5	3	12.5	109.9	91	40	21		(CL)	A-6(20)	Slightly Sandy Clay
P-7	1	10.9	123.4	68	32	14	2.2 (200 psf)	s(CL)	A-6(7)	Sandy Clay

SD = Sample Disturbed, NV = Non-Viscous, NP = Non-Plastic

Job No. 17-0034

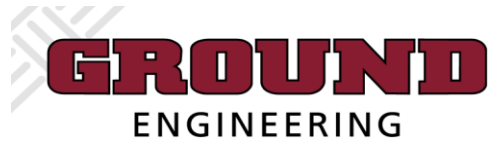


TABLE 2
SUMMARY OF SOIL CORROSION TEST RESULTS

Sample Location		Water Soluble Sulfates (%)	pH	Redox Potential (mV)	Sulfides Content	Resistivity (ohm-cm)	USCS Classifi- cation	Soil or Bedrock Type
Test Hole No.	Depth (feet)							
TH-2	5	0.01	8.1	-98	Positive	1,536	s(CL)	Sandy Clay

Job No.17-0035

Appendix A

Pavement Thickness Calculations

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Network Administrator

Flexible Structural Design Module

17-0034

Loveland Youth Sports Park: Phase 2

Loveland, Colorado

New Access Road

Full Depth Asphalt

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	73,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	2.82 in

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Thickness <u>(Di)(in)</u>	Width <u>(ft)</u>	Calculated <u>SN (in)</u>
1	Full Depth Asphalt	0.44	1	6.5	-	2.86
Total	-	-	-	6.50	-	2.86

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Network Administrator

Flexible Structural Design Module

17-0034

Loveland Youth Sports Park: Phase 2
Loveland, Colorado
New Acces Road
Composite Section

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	73,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	2.82 in

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Thickness <u>(Di)(in)</u>	Width <u>(ft)</u>	Calculated <u>SN (in)</u>
1	Full Depth Asphalt	0.44	1	4.5	-	1.98
2	Agg Base Course	0.11	1	8	-	0.88
Total	-	-	-	12.50	-	2.86

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Network Administrator

Flexible Structural Design Module

17-0034

Loveland Youth Sports Park: Phase 2

Loveland, Colorado

General Parking

Full Depth Asphalt

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	36,500
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	2.52 in

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Thickness <u>(Di)(in)</u>	Width <u>(ft)</u>	Calculated <u>SN (in)</u>
1	Full Depth Asphalt	0.44	1	6	-	2.64
Total	-	-	-	6.00	-	2.64

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Network Administrator

Flexible Structural Design Module

17-0034

Loveland Youth Sports Park: Phase 2
Loveland, Colorado
General Parking
Composite Section

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	36,500
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	2.52 in

Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	Struct Coef. <u>(Ai)</u>	Drain Coef. <u>(Mi)</u>	Thickness <u>(Di)(in)</u>	Width <u>(ft)</u>	Calculated <u>SN (in)</u>
1	Full Depth Asphalt	0.44	1	4	-	1.76
2	Agg Base Course	0.11	1	8	-	0.88
Total	-	-	-	12.00	-	2.64

GROUND

ENGINEERING

February 9th, 2018

Subject: Addendum #1, Alternate Pavement
Parameters, **Loveland Sports Park
Phase 2**, Loveland, Colorado

Job No. 17-0034

Mr. Scott Sinn
City of Loveland: Parks and Recreation
500 East 3rd Street
Loveland, Colorado 80537

Dear Mr. Sinn,

Ground Engineering Consultants, Inc. (GROUND) previously completed a subsurface exploration program to provide geotechnical and pavement section recommendations for design and construction of the Loveland Sports Park Phase 2, in Loveland, Colorado. The results were summarized in GROUND's report, titled, *Geotechnical Subsurface Exploration Program, Loveland Sports Park Phase 2, Loveland, Colorado*, Job No. 17-0034, prepared for City of Loveland: Parks and Recreation, dated December 21st, 2017.

Reference is made to our December 21st, 2017 report for a description of the site surface and subsurface conditions, our general geotechnical findings, parameters, and opinions, and the limitations on our work, which also apply to GROUND's conclusions and parameters provided herein. We consider all parameters and opinions in that report not specifically superseded herein to remain valid.

Recently GROUND was requested to provide updated pavement thicknesses based a site specific traffic study, alternative pavement thicknesses incorporating fly-ash pavement subgrade stabilization, and road base thickness parameters for the fire lane expansion were also requested.

Updated Pavement Section:

The client provided a traffic study memo performed for the site with a subject of *Loveland Sports Park Trip Generation and Parking Analysis*, dated November 21, 2017. An average annual daily traffic(AADT) of 1059 was obtained from this memo. We

assumed truck traffic of 0.5 percent single unit trucks and 0.5 percent tractor-trailer truck traffic (to account for fire truck traffic.) Based on these assumptions and utilizing CDOT calculations, this AADT was converted to an equivalent single axel load(EASL) of 44,800.

Chemical Stabilization It is possible that the native site soils will become unstable at moisture contents at or slightly above the optimum (during moisture treatment) that are still within the project moisture specifications. It may be preferred to perform chemical stabilization in the event that a stable base for pavement cannot be established by traditional methods. A typical subgrade remediation in the project area consists of treating the subgrade to a depth of 12 inches with fly-ash.

Based on the results of the calculations performed and stated assumptions the following pavement sections provided in the following table may be used for new asphalt placed at the project.

Minimum Pavement Section

<i>Location</i>	<i>Full Depth Asphalt</i>	<i>Composite Section</i>
	<i>(inches Asphalt)</i>	<i>(inches Asphalt / inches ABC)</i>
New Pavements	6.0	4.0 / 8
New Pavement over 12" of *fly-ash treated subgrade @ 12% mix rate	5.0	4.0 / 3

*Note: 5% Portland cement can be used in place of fly-ash.

General Fly-Ash Treated Subgrade Parameters

- **Chemical Stabilization:** Fly-ash treatment can be performed to a depth of 12 inches Based on our experience with the subgrade materials present at this site and other fly-ash treated subgrades, a minimum of 12% Type C Fly Ash by dry unit weight shall be used.
- **Weather Limitation:** The Fly Ash shall not be mixed or compacted if the temperature of the treated soil is below 35°F.
- **Equipment:** The equipment required shall include but not be limited to; grading and scarifying equipment, a spreader for the Fly Ash, mixing, pulverizing equipment or roto-miller, sheep's foot, pneumatic or vibrating rollers, grading equipment, sprinkling equipment, and trucks as approved by the owner.

- **General Construction Methods:** The contractor shall provide a completed subgrade containing a uniform Fly Ash mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and width; with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his/her work, to use the proper amount of Fly Ash, maintain the work, and rework the courses as necessary to meet the requirements.

Prior to beginning any treatment the subgrade shall be constructed and finished to smooth and uniform surfaces conforming to the grades and typical sections specified. The in-place density and moisture content should conform to the parameters provided for Fill Placement above.

After the subgrade has been finished and approved as specified, the subgrade shall then be cut and pulverized by a cutting and pulverizing machine to the depth and width shown on the Drawings. The machine shall cut and pulverize uniformly to the specified depth and shall have cutters that plane the base of the cut and pulverized zone to a smooth surface over the entire width of the cut. The machine must give visible indication at all times that it is cutting to the proper depth.

- **Application:** Fly Ash shall be spread only on that area where the mixing operations can be completed during the same working day.

The distribution of Fly Ash shall be attained over a measured section of subgrade until the proper amount of Fly Ash has been spread. The amount of Fly Ash spread shall be the amount required for mixing to the specified depth which will result in the percentage required.

- **Compaction:** Compaction of the Fly Ash/soil mixture shall begin immediately after final mixing with Fly Ash. The material shall be aerated or sprinkled as necessary to maintain the mixture within the specified moisture content limits during and following compaction. The field density for the compacted mixture shall be at least 95 percent of the maximum density of laboratory specimens prepared from samples taken from the treated soil material in place after mixing and prior to compacting. The specimens shall be compacted and tested in accordance with ASTM D 698. The in-place field density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922, as determined by the owner. Any mixture that has not been compacted shall not be left undisturbed for more than 30 minutes. The optimum moisture content shall be

determined in accordance with ASTM D 698. All compaction and compaction testing shall be completed within 1 hour of mixing the Fly Ash into the soil.

- **Finishing and Curing:** The completed section shall be cured for a minimum of 5 days before further courses are added or any traffic is permitted, unless otherwise directed by the owner. The surface should be kept moist for a minimum of 5-days by repeated sprinkling and watering in a manner acceptable to the owner and soil engineer.

Recycled Asphalt Surfaced Fire Lane:

Due to the infrequent and unpredictable nature of the traffic on a fire lane, typical AASHTO pavement design methods are not generally applicable. The thickness of the section is related to the amount of maintenance that will be required. Based on our experience with similar projects the following options are provided along with general maintenance estimations.

It is our understanding that the client intends to use recycled asphalt materials to surface the fire lane. The recycled asphalt materials should meet the requirements for CDOT Class 5 or 6 roadbase.

Alternate depths of aggregate base course and associated maintenance:

- 1) Eighteen (18) inches of base: Typical annual to every third year maintenance will be required. This section will be effective in providing extra support for heavily loaded vehicles.
- 2) Twelve (12) inches of base: Will increase maintenance especially if heavily loaded trucks / fire trucks are regularly driven on the section (on the order of 50,000 pounds or more). This thickness will likely require maintenance on the order of 1 to 3 times a year depending upon the amount of moisture received and the amount of ponding that occurs across the pad.

Regardless of which thickness of roadway is selected by the owner, the maintenance of the roadway will be impacted by the amount and size of traffic on the roadway and the severity and frequency of precipitation at the project site. The maintenance intervals noted above are estimations only and actual maintenance may be more or less.

We trust that this provided the additional information that you needed at this time. If you have any questions, please contact this office.

Sincerely,

GROUND Engineering Consultants, Inc.

Kelsey Van Bommel, P.E.

Reviewed by Joseph Zorack, P.E.



APPENDIX B

CSU SOIL TEST REPORT



Lab ID Number: H1181a.

Sample ID: LSP

Company Name: City of Loveland

Contact Name: Scott Sinn

Phone: (970) 962-2455 Ext:

Email Address: scott.sinn@cityofloveland.org

Client Type: Government/School

Current Plant Type: Native Vegetation

Proposed Plant Type: New Turfgrass

Current Irrigation: sprinkler

Current Amendments: none

Report Date: 2/12/2018

Invoice #: CC14630

Street Address: 500 E Third St

City: Loveland

County: Larimer

State: CO

Zip: 80537

Date Rcvd: 2/2/2018

Date Tested: 2/6/2018

Test Performed By: JS TD TCP

pH: 8.1

pH is high, but native and introduced plant species that are adapted to this pH should not be negatively affected.

Electrical Conductivity or Salts: 0.2 mmhos/cm

E.C. is Low. When E.C. less than 2.0, salinity is not a problem for plant growth.

Lime: Very High

Very High: Lime is greater than 5%. Plants can still grow quite well in soil with this lime content.

Texture Estimate: Sandy Clay Loam

This soil may drain at a low to very low rate. Watering schedules may have to be increased to allow for better water infiltration into the soil profile.

Sodium Absorption Ratio:

This value not requested.

Organic Material: 1.8 % **Plant Type:** New Turfgrass

Organic Matter is Low; For New Turfgrass add 3 cubic yards of OM per 1000 sq.ft. prior to seeding.

Nitrate: 2.0 ppm

When nitrate-N is less than 10 ppm, add N at these rates: For high maintenance turf: add 1 lb N/1000 sq.ft in each of 4 applications: (1) mid-March, (2) May-to-mid-June, (3) mid-Aug to mid-Sept., (4) and early Oct. to early Nov. For low maintenance turf: reduce applications (1) and (2) to 1/2 lb N/1000 sq.ft; application (4) is optional. For each 1 lb of N needed, apply 2 lb urea, or 5 lb ammonium sulfate, or 3 3/4 lb (27-3-4) lawn fertilizer, or 8 lb bloodmeal, or 11 lb corn gluten meal, or 50 lb alfalfa meal/pellets, per 1000 sq.ft. The number of nitrogen applications can be reduced or delayed if turf growth is vigorous in the spring.

Phosphorus: 11.2 ppm

Phosphorus is Low; Add 0.3 lbs. P2O5/100 sq.ft. or 3 lbs. P2O5/1000 sq.ft. Bone meal can be added at 3.5 lbs/100

sq.ft. or triplexsuperphosphate can be added at .7 lb/100 sq.ft. Multiply rates by 10 to convert to lbs/1000 sq.ft.

Potassium: 206.8 ppm

Potassium is High; No additional K2O is needed.

Zinc: 0.12 ppm

Zinc is Low; Add 4 oz. of Zn per 1000 sq.ft. or 10 lbs Zn/acre.

Iron: 6.7 ppm

Iron is Low; Add 2 oz. of Iron (Fe) per 1000 sq.ft. as iron chelate.

Manganese: 1.2 ppm

Manganese is Adequate; No additional Mn is needed.

Copper: 3.8 ppm

Copper is Adequate; No additional Cu is needed.

Boron: 0.50 ppm

Boron is High. No additional boron is needed.

Gypsum:

Gypsum is NOT Needed.

Additional Comments:

More information on turfgrass can be found at www.ext.colostate.edu. Additional information on lawn seeding and lawn care (mowing, watering, fertilizing, and thatch management) can be found at <http://csuturf.colostate.edu>.

James R Self, Ph.D, Director, Soil, Water and Plant Testing Lab