

Kirkland Heights Redevelopment

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PRODUCT SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 INTRODUCTION

Conform to the requirements of Division 00 and Division 01, including the General Conditions, Special Conditions, and Supplementary Conditions of the Contract.

1.2 WORK INCLUDED

Coordinate related requirements specified in other parts of the Project Manual.

1.3 PRODUCTS

Product selection shall comply with Section 01 60 00, Product Requirements.

1.4 SUBSTITUTIONS

- A. ~~During the bidding period or prior to the date~~ After a Contract is signed, submit written requests to **Owner** for substitutions.
1. Submit by fax or email with attachments, covered by Substitution Request Form attached to this Section. Complete all blank lines indicated on the form.
 2. ~~Submit ten calendar days, minimum, prior to scheduled bid date.~~ After contract date, the Architect, General Contractor and Owner may, at their option, consider certain other substitutions submitted in accordance with requirements of this section. However, unless a product has prior approval, a substitution request made after contract date for a product may be denied even though that product is used as the basis of the bid and contract.
 3. General Contractor will consult with Architect regarding the requested substitution, and will reply in writing in the space indicated on the bottom of the submitted form.
- B. Indicate one or more of following reasons for request:
1. Substitution is required for compliance with final code interpretation requirements or insurance regulation.
 2. Specified product is unavailable through no fault of Contractor, subcontractor or supplier.
 3. Subsequent information discloses specified product is unable to perform properly or fit designated space.
 4. Manufacturer or fabricator refuses to certify or guarantee performance of specified product as required.
 5. Substitution saves substantial cost, time, or other considerations. (Show accurate cost data on proposed substitution in comparison with product or method specified.)
- C. In making request for substitution, Supplier represents that:
1. It has personally investigated proposed product and, in its opinion, it is equal or superior in all respects to that specified.

2. It will coordinate installation of accepted substitution and guarantees to complete it in all respects. It has outlined any changes required in accordance with form.
 3. It will provide the same guarantee for substitution as for specified product.
 4. It waives all claims for additional costs related to substitution, which consequently become apparent.
 5. Cost data is complete and includes all related costs under its contract, but excludes:
 - a. Cost under separate contracts (show impact on attached form).
 - b. Design consultant's redesign, unless designated.
 6. It will comply with guidelines set forth in Evergreen Sustainable Development Standards (01 81 13).
- D. Substitutions will not be considered if:
1. They are indicated or implied on shop drawings or other project data submittals without proper notice shown on attached form.
 2. Acceptance will require substantial revisions of contract documents.

PART 2 PRODUCTS (not applicable)

PART 3 EXECUTION (not applicable)

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

- 1.1 Conform to the requirements of Division 00 and Division 01, including the General Conditions, Special Conditions, and Supplementary Conditions of the Contract.

1.2 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary ventilation.
 - 5. Telephone service.
 - 6. Facsimile service.
 - 7. Temporary water service.
 - 8. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Construction aids.
 - 2. Field offices and sheds.
 - 3. Vehicular access.
 - 4. Progress cleaning and waste removal.
 - 5. Project identification.
 - 6. Traffic regulation.
 - 7. Fire prevention facilities.
- C. Temporary Controls:
 - 1. Barriers.
 - 2. Security.
 - 3. Water control.
 - 4. Dust control.
 - 5. Erosion and sediment control: refer to Section 01 57 13.
 - 6. Noise control.
 - 7. Pollution control.
 - 8. Rodent control.
- D. Protection of property.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

Comply with federal, state, city, and all local codes and regulations.

1.4 TEMPORARY ELECTRICITY:

- A. The Owner will allow the Contractor to use current electrical service to the site for construction operations.
- B. Complement existing power service capacity, if any, and characteristics as required for construction operations.
- C. Provide distribution equipment, wiring, outlets, and branch circuits for power and lighting—as required by governing codes and as required for construction operations.

1.5 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations.
- B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide and maintain lighting to interior work areas after dark for security purposes.

1.6 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations. Permanent heating system may not be used for construction purposes.
- B. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Upon installation, seal all permanent ducts and vents to minimize contamination during construction. Take precautions to prevent construction dust from entering permanent ductwork and equipment. Remove any seals after construction is completed.

1.7 TEMPORARY VENTILATION

Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. Permanent heating system may not be used for construction purposes. Upon installation, seal all permanent ducts and vents to minimize contamination during construction. Take precautions to prevent construction dust from entering permanent ductwork and equipment. Remove any seals after construction is completed.

1.8 TELEPHONE SERVICE

Provide, maintain, and pay for telephone service to field office at time of project mobilization.

1.9 TEMPORARY WATER SERVICE

The Owner will allow the Contractor to use current water service to the site for construction operations.

1.10 TEMPORARY SANITARY FACILITIES

Provide and maintain required facilities and enclosures. Provide facilities at time of project mobilization.

1.11 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required by personnel to facilitate execution of work. Include scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, protective enclosures, and other such facilities and equipment. Refer to respective sections for particular requirements for each trade.
- B. As applicable, when permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.
- C. Maintain all facilities and equipment in a first class condition.

1.12 FIELD OFFICES AND SHEDS

- A. Provide Field Office: Weather tight, with lighting, electrical outlets, and heating equipment. Provide facilities at time of project mobilization.
- ~~B. Field Office limited to 20'x8' trailer.~~
- ~~C. Owner will provide space for Project meetings. Contractor to provide space for project meetings up to 20 attendees.~~
- D. Contractor to provide office for owner use (10' x 10').
- E. Removal: At completion of Work remove temporary buildings, foundations, utility services, and debris from the construction site and the adjacent paved parking lots.

1.13 VEHICULAR ACCESS

- A. Construct temporary all-weather access from public thoroughfares or the onsite parking areas to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes. Refer to TESC Plan in the drawings.
- B. Construct tire-wash area to remove mud from vehicle wheels before entering streets. Take precautions to prevent silty water from entering existing catch basins in the parking lot.
- C. Provide unimpeded access for emergency vehicles.
- D. Provide and maintain access to fire hydrants and control valves free of obstructions.
- E. Contractor is to maintain ingress/egress to the Crestline Apartments for tenant and emergency vehicles.

1.14 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.

1.15 TRAFFIC REGULATION

- A. Signs, Signals, And Devices:
 - 1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As required and approved by authority having jurisdiction.
 - 2. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
 - 3. Flag person Equipment: As required by authority having jurisdiction.
- B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.
- C. Haul Routes: If required by permit conditions, develop plan and obtain approval from authority having jurisdiction identifying public thoroughfares to be used for haul routes and site access.
- D. Removal: Remove equipment and devices when no longer required. Repair damage caused by installation.

1.16 FIRE PREVENTION FACILITIES

- A. Kirkland Heights Apartments is a No Smoking property. Refer to on-site property management for No Smoking Policy for details.
- B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Develop and supervise a comprehensive fire prevention and fire protection program. Instruct personnel in the methods and procedures of the program. Post warnings and information and enforce strict discipline. Review needs with local fire department and establish procedures to be followed. Maintain unobstructed access to extinguishers, hydrants, stairways, and other escape routes and access routes for firefighting.
- D. Provide one fire extinguisher at each stair on each floor of buildings under construction and/or demolition.
- E. Provide minimum one fire extinguisher in every construction trailer and storage shed.

1.17 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing buildings.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.18 SECURITY

- A. Security Program:
 - 1. Protect Work, and existing premises from theft, vandalism, and unauthorized entry.
 - 2. Initiate program at project mobilization.
 - 3. Maintain program throughout construction period until Owner occupancy.
- B. Entry Control:
 - 1. Restrict entrance of unauthorized persons and vehicles into Project site and existing facilities. Allow entrance only to authorized persons with proper identification.
 - 2. Maintain log of workers and visitors, make available to Owner on request.

1.19 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.20 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.

- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- 1.21 EROSION AND SEDIMENT CONTROL
Refer to the permitted drawings and specifications.
- 1.22 NOISE CONTROL
Provide methods, means, and facilities to minimize noise from, and noise produced by, construction operations.
- 1.23 POLLUTION CONTROL
 - A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
 - B. Comply with pollution and environmental control requirements of authorities having jurisdiction.
- 1.24 RODENT CONTROL: Provide methods, means & facilities to prevent rodents from accessing or invading premises.
- 1.25 PROTECTION OF PROPERTY
 - A. Protection of work and existing property:
 - 1. Protect existing structures, property, landscaping and other surface improvements from damage, including but not limited to sidewalks, driveways, curbs, pavements, utilities, adjoining property and structures. Provide bracing, shoring, or other means necessary for such protection.
 - 2. Prevent dust or debris from entering into adjacent areas. Take measures necessary to avoid tracking dust and mud onto adjacent streets and site finishes.
 - 3. All damage resulting from the Work of this Contract, whether inside or outside the Limits of Work, and whether private, public, or franchise utility property, shall be repaired/replaced by this Contractor to a condition equal to or better than that existing prior to the damage with no increase to the Contract Amount.
 - 4. The location of fences, trees and other landscaping, and other objects shown on the survey or the drawings is provided solely to provide the probable location of such object(s), and may not be precise or complete. Contractor shall confirm exact locations before beginning the Work.
 - B. Minimize disruption to adjacent property owners. Repair impacted property and/or facilities when damage is done.

- C. Maintain existing utility services to adjacent buildings. Schedule and conduct the Work to avoid shutdowns and interferences of services to adjacent property owners.
- D. Protection of roadways and sidewalks:
 - 1. Protect from damage existing sidewalks, curbs, gutters, aprons, driveways and other pavements. Install cribbing, wood or metal sheeting, or other such measures to minimize damage.
 - 2. Maintain existing illumination patterns for signs and roads at all times.
 - 3. Maintain existing signage at all times.
- E. Protection of existing utilities:
 - 1. Protect all existing utilities, both above and below ground, whether identified or unknown, from damage. Notify Owner and immediately of utilities encountered that were not identified on the drawings.
 - 2. Above and below ground utilities not identified on the drawings may be encountered during the course of the Work. The Contractor shall coordinate with, and pay the costs associated with, a utility locating service (see below). Existing utilities shown on the drawings represent the best information available and are based upon recorded information available to the property surveyor, or from information provided by the owners of underground facilities. Also, other work in the area may have recently installed utilities that are not shown on the Contract Documents.
 - 3. Contractor shall contact utility companies in the vicinity of this Work. No construction shall begin until utilities within and adjacent to these Limits of Work have been located and marked.
 - 4. At least two days, and not longer than ten business days prior to commencing excavation work on this site, the Contractor shall notify the Underground Utilities Location Center of the planned excavation and its schedule. The Contractor shall also notify utility providers directly who are not part of the One-Call system for locations of their facilities and/or equipment.
 - 5. All utility components that are buried (valves, manholes, vaults, or pull boxes) shall be conspicuously marked by the Contractor to allow their location to be determined by other utility personnel under adverse conditions (inclement weather or darkness). Stake end points of underground components. Color code and mark stakes to clearly identify utility types.
 - 6. If utility conflicts occur, the Contractor shall proceed with construction in other areas of the Work. In the event utilities are damaged during construction, temporary repairs must be made immediately to maintain continuity of services. Under no circumstances shall damaged utility service be left unrepaired overnight.
 - 7. In addition to marking utilities at the beginning of the Work, the Contractor shall record underground utilities on the work site after the completion of the Work.
- F. Power, Telephone and CATV lines:
 - 1. If relocation of power lines becomes necessary, Contractor shall coordinate and pay all costs of such relocation. Contractor(s) to maintain

as a minimum all Washington State Labor and Industry safety clearances.

2. Contractor shall notify the appropriate communications company one week prior to work in the vicinity of overhead lines.

H. Archaeological and historic objects:

1. All cultural resources, including isolated artifacts as well as significant historic property, shall be avoided and, if discovered, shall be actively protected to the greatest extent possible. Such resources include archaeological or historic objects such as ruins, sites, buildings, artifacts, fossils, human remains of any age, or other such objects of antiquity that may have significance from a historic or scientific standpoint.
2. At the Contractor's option, a training session can be arranged at the beginning of Work on site to brief construction personnel on cultural resource issues. The training will be led by a qualified professional archaeologist and will include information on the legal context of cultural resources protection, and on the prehistoric, ethnographic, and historic cultural resources likely to be present. The primary goal of the training will be to familiarize personnel with the procedures to be followed in the event of discovery of cultural material, and to provide contact protocols. The training will include examples and explanations of how to recognize archaeological materials.
3. If any evidence is found or unearthed that matches the criteria, immediately do the following:
 - a. Stop work in the vicinity of the discovery.
 - b. Contact the Owner, who will in turn contact a qualified Archaeological Consultant for a site assessment.
 - c. Protect the discovery from additional disturbance, and secure the discovery area (cover with a tarp to protect from weather, flag with caution tape to keep unauthorized persons from the discovery, etc.).
 - d. Expand or shrink the boundaries of the discovery area depending upon the assessment by the Consultant.
 - e. Do not resume work within the boundary until notified by the Owner and Consultant in writing that it is proper to do so.
4. Do not pick up, excavate, or otherwise disturb cultural objects or deposits. Collection of artifacts by the Contractor's personnel or any others with access to the worksite will not be tolerated.
5. If the discovery includes human remains, whether burials or isolated teeth or bones, or if other mortuary items are discovered, proceed as follows in addition to the above:
 - a. Do not photograph remains or artifacts.
 - b. Secure and protect the site as described in 3.c above and report the presence and location of these remains to the project Superintendent. The Superintendent will report the presence and location of these remains to the Owner and King County Sheriff, who will contact the Medical Examiner (ME). The ME will assume

jurisdiction over the skeletal remains and make a determination of whether those remains are forensic or non-forensic.

6. Claims for an increase in the Contract Sum and/or the Contract Time related to the discovery of archaeological or historic objects may be brought by the Contractor in accordance with Section 01 26 00 - Contract Modification Procedures.

1.26 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion inspection.
- B. Remove abandoned underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION

SECTION 02 32 00
GEOTECHNICAL INVESTIGATIONS

See attached:

Geotechnical Report date May 15, 2023 – 58 Pages

Geotechnical Memorandum date March 1, 2022 – 12 Pages

Geotechnical Memorandum date November 23, 2022 – 26 Pages

END OF SECTION

SECTION 03 54 13

GYPSUM CAST UNDERLAYMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes liquid applied gypsum based self-leveling floor underlayment for installation over wood framed floors.
- B. The Owner has established sustainability goals for this project, and this Section contains specific information and requirements for compliance. Refer to Section 01 81 13 for specific requirements.
- C. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 06 17 33 - Wood I-Joists.
 - 3. Section 09 21 16 – Gypsum Board Assemblies.
 - 4. Section 09 65 00 – Resilient Flooring.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete.
 - 2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association: NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- C. Underwriters Laboratories Inc.: UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit physical characteristics and product limitations. Include test data from an independent testing agency to substantiate fire protection and acoustic performance required by the floor/ceiling assemblies in the Drawings.
- C. Manufacturer's Instructions: Indicate mix and application instructions.

1.4 QUALITY ASSURANCE

- A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- B. Fire and Acoustic Performance: Drawings indicate certain fire ratings and acoustic properties for products of this Section used in floor/ceiling assemblies. Manufacturer shall provide testing reports from an independent testing agency substantiating product performance for both fire rating and acoustic performance.

1.5 QUALIFICATIONS

Manufacturer and Applicator: Company specializing in manufacturing and installing Products specified in this section with minimum three years experience.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install underlayment until floor penetrations and peripheral work are complete.
- C. Maintain manufacturer's recommended minimum ambient temperature and humidity for 24 hours before, during and for 72 hours after installation of underlayment, or as otherwise noted in writing by the manufacturer.
- D. During curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. United States Gypsum Company, Chicago IL: Levelrock 2500
 - 2. Substitutions: Section 01 25 13 – Product Substitution Procedures.
 - a. Floor/Ceiling assembly is proprietary – refer to A5.52 & A5.53 for referenced Gypsum Associated assembly.
 - b. Substitutions only acceptable if entire assembly has been tested to comply with minimum 1 hour rating, minimum IIC rating of 50 and minimum STC rating of 60.

2.2 MATERIALS

- A. Underlayment: Gypsum based proprietary mix; thickness as noted on drawings.
- B. Water: Potable and not detrimental to underlayment mix materials.
- C. Primer: Manufacturer's recommended type.
- D. Joint and Crack Filler: Latex based.
- E. Sound Deadening Mat: USGC LevelRock Brand SAM-N25.

2.3 MIXING

- A. Site mix materials.
- B. Mix to achieve following characteristics:
 - 1. Density: 115 lb/cu ft minimum dry density.
 - 2. Compressive Strength: 2,000-3,200 psi in accordance with ASTM C472.
- C. Mix to self-leveling consistency.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

- B. Verify substrate surfaces are clean, dry, unfrozen, do not contain petroleum by-products, or other compounds detrimental to underlayment material bond to substrate. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin installation until all unsatisfactory conditions are resolved.
- D. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.2 PREPARATION

- A. Remove substrate surface irregularities. Fill voids and deck joints with USG "Durabond 90" filler material or approved equal. Finish smooth. Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
- B. Vacuum clean surfaces.
- C. Prime substrate if required by the manufacturer. Allow to dry.
- D. Mask and protect adjacent surfaces and materials from damage.
- E. Cover floor drains as necessary to prevent clogging.

3.3 PLACEMENT OF SOUND DEADENING PAD

- A. Schedule the sound deadening pad system as late as possible in the construction cycle. ~~If sound deadening pad is to be installed before drywall, then 3.4 lb. sq. yd. galvanized metal lath must be loose laid over the entire surface.~~
- B. Install sound deadening pad following manufacturer's recommendations and specifications.
- C. Priming: Prime sound deadening pad as required by manufacturer.

3.4 APPLICATION

- A. Install underlayment in strict compliance with the manufacturer's instructions.
- B. Place to thickness as indicated on Drawings.

3.5 CURING

- A. Air cure.
- B. Provide adequate ventilation above and below for complete drying. If required, heat spaces to ensure drying.

3.6 APPLICATION TOLERANCE

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface: Level to 1/8 inch in 10 ft.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Placed Material: Inspecting for conformance to specification requirements.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished Work.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

3.9 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Refer to Section 01 74 19 for specific requirements.

END OF SECTION

05 52 13
HANDRAILS

PART 1 - GENERAL

1.1 WORK IN THIS SECTION

- A. Section includes:
 - 1. Metal handrails
 - 2. Associated hardware.

1.2 REFERENCES

AISC American Institute of Steel Construction
AISI American Iron and Steel Institute
AWS American Welding Society
COK City of Kirkland Pre-approved Plans
IBC International Building Code
SBC City of Seattle Building Codes and Regulations

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's published literature for specified products and accessories as applicable including manufacturer's specifications, performance calculations, and physical characteristics.
- B. Shop Drawings: Submit to the Landscape Architect for approval, shop drawings, details of fabrication with dimensions and connections shown.
- C. Color or Finish Samples: The Contractor shall submit for selection colors available from manufacturer's standard color line.

1.4 PROJECT CONDITIONS

- A. Field-verify stair dimensions prior to commencing fabrication. Notify Owner or Owner's Representative if discrepancies exist between plans and actual conditions.

1.5 QUALITY ASSURANCE

- A. All construction shall be in accordance with the City of Kirkland Pre-approved Plans.
- B. Steel fabricator shall be experienced in steel fabrication including: cutting, bending, fastening, and finishing.
- C. Welders shall be certified by Washington Association of Building Officials (WABO) for structural welding.
- D. All products supplied will comply with applicable State and Local codes.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Coordinate work of other trades specified elsewhere.
- B. Ship, store, and handle all items so as to protect metal components from damage on site. Store in a safe location, out of pedestrian and vehicular traffic and protected from weather. Repair or replace any damaged components before installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Handrails:

1. Base: Galvanized Steel Pipe
Alternate: Schedule 40 powder coated galvanized steel pipe
2. If requested, special exceptions for unique applications shall be either Painted, Powder Coated, Aluminum or Stainless Steel, only as approved by the Landscape Architect during the design/technical review process.
3. Paint (if selected): Kynar 500 Paint system, or approved equal. Color shall be selected by the Landscape Architect after submittal of color samples.

B. Paint (if selected): Kynar 500 Paint system, or approved equal. Color shall be selected by the Landscape Architect after submittal of color samples.

PART 3 - EXECUTION

3.1 Installation

- A. Connect handrail pipe to concrete pavement as shown on the Drawings. Handrails to be set straight, true, and plumb without curves and bends, except by design.
- B. Coordinate post embedment placement with concrete contractor.

3.2 Materials and Finishes

- A. Hot-dipped galvanizing after fabrication is required and is the preferred finish.

END OF SECTION

SECTION 07 76 00
CONCRETE PAVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete paver units.
 - 2. Pedestal support system.
 - 3. Other system components, provided by Installer.

1.2 RELATED SECTIONS

- A. Section 32 14 00 - Unit Paving
- B. Section 32 14 43 - Porous Unit Paving.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: For roof paver units and pedestal support system layout; indicate adjacent construction, perimeter containment components, penetrations, attachment details, and other conditions.
 - 1. Include data indicating compliance with performance requirements.
- C. Samples for Initial Selection: For each type of roof paver unit, provide representative charts of manufacturer's full range of patterns, textures, and colors.
- D. Samples for Verification: For each type of exposed finish for each roof paver unit selected.
 - 1. Roof Paver Units: Manufacturers' standard size, 24 by 24 inches.
 - 2. Accessories: Adjustable pedestal support, and shims.
- E. Delegated Design Submittal: For pedestal support system installation, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For delegated design engineer.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Sample Warranty: For warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof paver units and pedestal support system to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Include inventory list of items delivered.
 - 1. Roof Paver Units: Full-size units in quantity equal to 5 percent of quantity installed for each type, pattern, color, and size.
 - 2. Pedestal Supports: Units in quantity equal to 5 percent of quantity installed for each type and size. Include manufacturer-furnished adjustment tool.
 - 3. Deliver materials to location determined by Owner.

1.8 QUALITY ASSURANCE

- A. Delegated Design Engineer: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

1.9 MOCKUPS

- A. Mockup: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup in size and location indicated on Drawings, or if not indicated, no fewer than four roof paver units and nine pedestal supports.
 - 2. Acceptance of mockups does not constitute acceptance of deviations from the Contract Documents contained in mockups unless Architect specifically accepts such deviations in writing.
 - 3. Subject to compliance with requirements, accepted mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect products during shipping, handling, and storage to prevent staining, chipping, deterioration of components, or other damage. Store unused materials in original packaging.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace the following:
 - 1. Damaged roof paver units that are delivered to Project site chipped, cracked, or broken prior to being unpackaged.
 - 2. Roof paver units and pedestal supports that fail in materials or workmanship within specified warranty period when installed and used in accordance with manufacturer's written instructions.
 - 3. Manufacturer's Warranty Period: Five years from date of Substantial Completion.
 - 4. Installer's Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain roof paver units and pedestal support system from single source or producer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pedestal support system and perimeter containment system.
- B. Pedestal Support System: Capable of withstanding effects of gravity loads and the following loads and stresses, within limits and under conditions indicated:
 - 1. Roof Terraces: Uniform load of 125 lbf/sq. ft. or a concentrated load of 2000 lbf, whichever produces greater stress.
- C. Perimeter Containment System: Capable of resisting lateral forces in pedestal roof paver support system without displacement exceeding 1/8 inch.

2.3 CONCRETE PAVER UNITS

- A. Concrete Pavers: Complying with ASTM C936/C936M and resistant to freezing and thawing when tested in accordance with ASTM C1645/C1645M; made from normal-weight aggregates, molded- or extruded-concrete roof paver units, with integral color, and free of surface imperfections; intended for exterior use with roof paver support system.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mutual Materials Inc; Concrete Vancouver Bay Series Concrete Pavers or approved equal.
 - 2. Nominal Weight: 22 lb/sq. ft..
 - 3. Nominal Size: 24" x 24".
 - 4. Nominal Thickness: 1 3/4".
 - 5. Edge: Manufacturer's standard.
 - 6. Color: Charcoal

2.4 PEDESTAL SUPPORT SYSTEM

- A. Adjustable-Height-Pedestal Paver Supports: Continuously variable, adjustable-height, high-impact and flame-resistant high-density polypropylene system components. Accommodate height adjustments from 1/2 to 52 inches to provide level paver installation. System shall maintain 1/8- to 1/4-inch paver joint width and alignment of pavers while allowing for drainage, air circulation, and prevention of water accumulation.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Appian Way Pedestal System (AWS) or comparable product by one of the following:
 - a. Tile Tech Inc.; Hybrid Uni-Just .
 - 2. Load Capacity: Not less than 2000 lbf.
- B. Fixed-Height-Pedestal Paver Supports: High-impact and flame-resistant ABS plastic system components of varying thickness, stackable to accommodate height adjustments from 1/2 to 2 inches. System shall maintain 1/8- to 1/4-inch paver joint width and alignment of pavers while allowing for drainage, air circulation, and prevention of water accumulation.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Appian Way Pedestal System (AWS) or comparable product by one of the following:
 2. Tile Tech Inc.; Stak-Cap
 - a. Load Capacity: Not less than 1500 lbf.
 - C. Paver Support System Components and Accessories: Provide manufacturer's standard high-impact and flame-resistant high-density polypropylene or ABS plastic spacer tabs, shims, extenders, reducers, lateral bracing support members, and other accessories as necessary for a complete assembly.
- 2.5 Other System Components, Provided by Installer
- A. Protection Course: As recommended by roofing membrane manufacturer to prevent damage to roofing while allowing adequate flow to drainage system.
 - B. PVC Pipe: Nominal 4-inch OD SDR35 PVC sewer pipe complying with requirements of ASTM D3034 or ASTM F679. Cut pipe to heights to suit Project.
 - C. Perimeter Containment System: Materials and components provided by Installer to restrain pedestal roof paver support system.
- 2.6 MATERIALS
- A. ABS Plastic: Complying with ASTM F2806.
 - B. High-Density Polypropylene: Having a self-ignition temperature of 650 deg F or greater when tested in accordance with ASTM D1929.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roofing membrane installation, with roofing Installer present, for protection from pedestal support system installation. Examine areas where roofing system is turned up or flashed against vertical surfaces and horizontal roofing.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install protection course over roofing membrane in accordance with roofing manufacturer's written instructions.
- B. Coordinate placement of pedestal support system with roofing membrane Work.

3.3 INSTALLATION, GENERAL

- A. Install systems and components in accordance with manufacturer's written instructions and accepted Shop Drawings.
- B. Mix roof paver units from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

- C. Cut roof paver units with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full roof paver units without cutting where possible. Hammer cutting is not acceptable.
- D. Joint Pattern: Grid.
- E. Units over Roofing: Exercise care in placing roof paver units and setting materials over roofing so protection materials are not displaced and roofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged roofing before covering with roof paver units.

3.4 INSTALLATION OF PEDESTAL SUPPORT SYSTEM

- A. Lay out and mark pedestal support locations on top of protection course. Install bearing pads below pedestal supports.
- B. Accurately set pedestal supports in locations coordinated with approved roof paver layout.
- C. Install lateral bracing support system components.
- D. Adjust pedestal support heights prior to, and following, installation of roof paver units. Shim where fine adjustment is necessary using manufacturer-provided shims.

3.5 INSTALLATION OF ROOF PAVER UNITS

- A. Do not use roof paver units with chips, cracks, voids, discolorations, edge damage, and other defects that might be visible or cause staining in finished work.
- B. Install roof paver units over pedestal support system, maintaining a uniform joint width. Align joint patterns parallel in each direction.
 - 1. Lay out units to avoid less-than-half-width units at perimeter or other terminations.
- C. Set roof paver units in place using placement methods that result in stable installation free from rocking.
- D. Tightly seat roof paver units against spacers to eliminate lateral movement or drift of paving assembly. Make final in-place level adjustments using manufacturer's furnished tool to adjust paver support heights.

3.6 CONSTRUCTION TOLERANCES

- A. Variation of Level Across Width of Each Roof Paver Unit: 1/16 inch, maximum.
- B. Variation from Level: Do not exceed 1/4 inch in 10 ft., when measured at any location and in any direction.
- C. Variation in Joint Width: Do not vary joint thickness more than one-fourth of nominal joint width.
- D. Variation in Plane at Joints (Lipping): Do not exceed 1/16 inch difference between planes of adjacent roof paver units.
- E. Variation in Line of Edge at Joints (Lipping): Do not exceed 1/16 inch difference between edges of adjacent roof paver units, where edge line continues across joint.

3.7 CLEANING AND PROTECTION

- A. Remove and replace loose, chipped, broken, stained, or otherwise damaged roof paver units or units that do not match adjoining units or pattern indicated on Drawings.
- B. Cleaning: Remove soiling from exposed surfaces; wash and scrub clean. Leave joints between roof paver units open and clean of debris to allow for proper drainage and airflow.
- C. Provide final protection and maintain roof paver units without damage or deterioration at time of Substantial Completion.

3.8 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Refer to Section 01 74 19 for specific requirements.

END OF SECTION

SECTION 08 53 00

PLASTIC (PVC) WINDOWS AND SLIDING GLASS DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Factory fabricated tubular extruded plastic (PVC) windows in sliding and single hung configurations and glass patio doors. Units to be factory glazed, with integral nailing fin, operating hardware and insect screens.
 - 2. Schedule of windows and sliding glass doors: refer to the drawings.
 - 3. Section includes detailed instructions for installation and air leakage testing of flanged windows.
- B. Performance Requirements:
 - 1. System Design: Design and size components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of window.
 - 2. Primary Performance Requirements: windows to meet or exceed performance criteria for ANSI / AAME / NWWDA 101/I.S.2. designation C20 Commercial windows.
 - 3. Uniform Structural Load: Uniform Structural Load Test at 150% of Design Pressure. Test shall be conducted in accordance with ASTM E 330.
 - 4. Assembly: To accommodate without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.
 - 5. Thermal Resistance of Assembly: U-Value of 0.27 or better when measured in accordance with NFRC 100. Solar Heat Gain Coefficient (SHGC) of 0.35 or better.
 - 6. Vapor Seal: No vapor seal failure at lineal static pressure of 1 inch, 72 degrees F, and 40% of relative humidity.
 - 7. Condensation Resistance Factor: CRF of 60* when measured in accordance with AAMA 1503.
 - 8. Water Leakage: None, when measured in accordance with ASTM E 331 at a pressure differential of 15psf in the lab. None, when measured in accordance with field test AAMA 502-08 using a uniform static air pressure difference of (Product rating dp x .15 x .667) psf with a minimum field test pressure differential of 6psf.
 - 9. System internal Drainage: Drain water entering assembly, condensation occurring in glazing channels, or migrating moisture within the system, to the exterior via a weep drainage network.
 - 10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air barrier and vapor retarder.
 - 11. Thermal Movement: Design sections to permit normal movement caused by thermal expansion and contraction of vinyl members to suit glass, infill, and perimeter opening construction.
 - 12. Design Temperature Range: 120° F.

- 13. Noise Reduction (NR) rating for acoustic windows: See window schedule for requirements
- C. It is a specific requirement of this Section that non-toxic and low-VOC products be used for this project, and that all interior paints, coatings, adhesives and sealants meet specified requirements. Refer to Section 01 81 15 & 01 81 19.
- D. Design and performance criteria for this Section regarding health, safety and durability shall take precedence over sustainable design criteria. The Contractor shall inform the Owner and Architect of any conflicts that may result between the noted recycled content and the strength of the materials.
- E. Related Sections:
 - 1. Section 06 10 00 – Rough Carpentry: Wood framed openings.
 - 2. Section 07 27 00 – Weather Resistive Barriers.
 - 3. Section 07 65 00 – Flexible Flashings.
 - 4. Section 07 90 00 – Joint Protection.

1.2 REFERENCES

- A. American Architectural Manufacturers Association:
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors; American Architectural Manufacturers Association.
 - 2. AAMA 303 - Voluntary Specification for Poly (Vinyl Chloride) (PVC) Exterior Profile Extrusions.
 - 3. AAMA 501.2-03 – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
 - 4. AAMA 502-08 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
 - 5. AAMA 503-03 – Voluntary Specification for Field Testing of Storefronts, Curtain Walls and Sloped Glazing Systems.
 - 6. AAMA 511-08 – Voluntary Guideline for Forensic Water Penetration Testing of Fenestration Products.
 - 7. AAMA 613 - Voluntary Performance Requirements for Test Procedures for Organic Coatings on Plastic Profiles.
 - 8. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association
 - 9. AAMA/I.S.2/A440-08 – AAMA Gold Label Program: North American Certification Program for Mass Manufactured Products (Harmonized CSA and 101 ANS).
- B. American Society of Civil Engineers: ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
 - 1. ASTM C1036 - Specification for Flat Glass.
 - 2. ASTM C1048 - Specification for Heat-Treated Flat Glass - Kind HS, Kind FT - Coated and Uncoated Glass.
 - 3. ASTM D3656 - Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.

4. ASTM D4726 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors.
5. ASTM E1105-00 – Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtainwalls, by Uniform or Cyclic Static Air Pressure Difference.
6. ASTM E783-02 – Standard Test Method for Field Measurement of Air Leakage Through installed Exterior Windows and Doors.
7. ASTM E2112-07 - Standard practice for Installation of Exterior Windows, Doors and Skylights.
8. ASTM E2128-01a – Standard Guide for Evaluating Water Leakage of Building Walls.
9. ASTM E2099-00(2007) – Standard Practice for the Specification and Evaluation of Pre-Construction Laboratory Mockups of Exterior Wall Systems.
10. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
11. ASTM E330-02 – Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
12. ASTM E331-00 – Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.
13. ASTM E547-00 – Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Cyclic Static Air Pressure Differential.
14. ASTM F588-07 – Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.
- D. Glass Association of North America: GANA - Glazing Manual.
- E. National Fenestration Rating Council Incorporated: NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

1.3 SYSTEM DESCRIPTION

- A. Windows: Extruded tubular plastic (PVC) sections, factory fabricated, vision glass, integral nailing flange, related flashings, anchorage, window operating control device (WOCD) (Safety Vent Latch – see attached), and attachment devices.
- B. Configuration: Conform to AAMA 101 Designations for fixed and operating sash designs shown on the drawings.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Schedule to indicate:
 1. Manufacturer
 2. Model number
 3. Type
 4. Design Pressure Rating

5. U-factor
 6. SHGF value
 7. CRF Value
 8. Size
 9. Frame Color
 10. Glazing type
 11. Vent / no vent
 12. CPD Number
- C. Shop Drawings: Submit window schedule indicating each unit size, rough-opening dimensions, framed opening tolerances, affected related work, location of fresh air port(s) and installation requirements.
- D. Product Data: Submit component dimensions, anchorage and fasteners, glass, internal drainage, and typical details.
- E. Samples: Submit two window and frame sections, 12 x 12 inch in size, illustrating window frame section, mullion section, screen and frame, and finished surfaces
- F. Manufacturer's Certificates: Certify Product performance ratings by NFRC as meeting or exceeding specified requirements.
- G. Energy compliance labels: refer to paragraph 3.5 below.
- H. VOC Limits: Include manufacturer's data sheets for each adhesive, coating and sealant used in this Section identifying VOC limits and chemical components. All adhesives must conform to the South Coast Air Quality Management District Rule 1168 and all sealants must conform to Bay Area Air Quality Management District – Regulation 8, Rule 51.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
1. Fabricate window assemblies in accordance with AAMA 101 for types of windows required.
 2. Insulated Glass: Fabricate insulated glass units in accordance with GANA (formerly FGMA) Glazing Manual.
- B. **Wall and Window Installation Mock-Up:** The General Contractor will direct the building of a mock-up wall independent of the building envelope for the Architect and Owner to review with all products and trades included in the window assembly. At the selected mock-up location, all products of the each of the exterior wall assemblies (existing wood frame, windows, metal flashing, self-adhering membranes, air/water barriers, etc.) will be installed and inspected at various stages of installation. Perform the mock-up installations of the entire window assembly. These mock-up locations will be evaluated for constructability and may be tested for weather-tight qualities. Modifications, if any, to the exterior wall assemblies resulting from the mock-up will be discussed, documented by the contractor and incorporated into the work per ESDS-7.13. Contractor to coordinate with mock-up required in Section 07 21 16 Blanket Insulation & 07 21 13 Board Insulation.
1. Subcontractor(s) responsible for the work of this section required to attend.
 2. Subcontractor(s) responsible for the work of this section required to supply two typical residential windows, one operable and one fixed, for the mock up.

3. Location to be coordinated with Owner.
4. Provide Owner with one week's notice prior to installation
- C. Window testing: refer to the Part 3 Execution portion of this Section.
- D. Qualifications:
 1. Manufacturer: Company specializing in manufacturing commercial windows with minimum five years experience, and with service facilities within 100 miles of Project.
 2. Installer: Company specializing in installation of commercial windows with minimum five years experience, and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver to site in manufacturer's original unopened containers and packaging, with labels clearly identifying manufacturer and product name.
- C. Protect flanges and finished surfaces with wrapping and/or boxing. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- D. Jig, brace, and box window frame assemblies for transport to minimize flexing of members and to minimize flexing of joints. Store off ground in a vertical position.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install glazing materials when ambient temperature is above or below manufacturer's stated limits. Maintain this temperature range during and after installation of sealants.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Correct defective Work within a five-year period after Date of Substantial Completion.
- C. Furnish ten-year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of color finish.

PART 2 PRODUCTS

2.1 VINYL WINDOWS

- A. Manufacturer: Ply Gem Windows, Cary, NC (with offices in Auburn, WA)
- B. Other Manufacturers accepted:
 1. VPI Quality Windows, Spokane, WA;
 2. Substitutions: Section 01 25 13 – Product Substitution Procedures.
- C. Substitutions: Section 01 60 00 – Product Requirements
- D. Product Description:

1. Window Types A and B: Ply Gem 200 Pro Sliding, hollow tubular ultra-violet resistant polyvinyl chloride (PVC) window frames with welded corner construction. Configurations of sash as scheduled on the drawings.
 2. Window Types C and D: Ply Gem 200 Pro Casement, hollow tubular ultra-violet resistant polyvinyl chloride (PVC) window frames with welded corner construction. Configurations of sash as scheduled on the drawings.
- E. All units to be NFRC rated.

2.2 VINYL SLIDING PATIO DOOR

- A. Manufacturer:
1. Ply Gem Windows, Cary, NC (with offices in Auburn, WA)
 2. Substitutions: Section 01 60 00 – Product Requirements
- B. Other Manufacturers accepted:
1. VPI Quality Windows, Spokane, WA;
 2. Substitutions: Section 01 25 13 – Product Substitution Procedures
- C. Product Description: Ply Gem Pro Series 960 Sliding Patio Door, hollow tubular ultra-violet resistant polyvinyl chloride (PVC) window frames with welded corner construction. Configurations of fixed and operable sash as scheduled on the drawings.
- D. All units to be NFRC rated.

2.3 COMPONENTS

- A. Minimum energy conservation requirements: U-value 0.26 or better for entire unit.
- B. Insulating Glass: HP2+ sealed double pane units, 3/4" inch thick, Low-E argon filled, conforming to the following.
1. Outer Pane: Clear, Low-E coating, float glass, ASTM C1036, Quality 1.
 2. Inner Pane: Clear float glass, Interior Surface Low-E, ASTM C1036, Quality 1.
 3. Tempered: Clear, ASTM C 1048.
 4. Pane Thickness: 1/4".
 5. U-value center of glass: 0.26 (summer daytime) and 0.28 (winter night time).
 6. Solar Heat Gain Coefficient (SHGC): 0.27.
 7. Visible Light Transmittance: 64%.
 8. Locations: All units except those specifically identified on the window schedule(s).
- C. Window Frame: Extruded multi-chambered PVC frame with integral ultra-violet degradation resistance, continuous integral nailing fin; depth 3-7/16 inches; nominal wall thickness 0.050 to 0.080 inches; corners mitered and heat welded.
- D. Window Hardware: Sash lock: Lever handle with cam lock. Install at factory. Standard crank handles for casement windows, standard handle for awning windows. Locate hardware within 48-inches of finished floor.
- E. Window Sills: Tubular; sloped for positive wash; one-piece full width of opening.

- F. Operable Sash Weather Stripping: Manufacturer's standard; permanently resilient, profiled to effect weather seal.
- G. Patio Door Frame: Extruded multi-chambered PVC frame with integral ultra-violet degradation resistance, continuous integral nailing fin; depth 4-3/8 inches; nominal wall thickness 0.050 to 0.080 inches; corners mitered and fusion welded.
- H. Patio Door Hardware: Smooth gliding rollers; two-point lock with adjustable strike. Anodized aluminum threshold cover.
- I. Color: White PVC frame and hardware.
- J. Insect Screen Frame: manufacturer's standard frame of rectangular sections; nominal size similar to operable glazed unit.
- K. Insect Screens: gray color.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard.

2.5 FABRICATION

- A. Integral nail flange.
- B. Units to be factory assembled and glazed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section. Refer to step-by-step procedure for wrapping rough openings shown on the drawings.
- C. Verify that window units are sized as required to provide an open perimeter shim space of not less than 1/4" nor more than 1/2" in any location, or as otherwise required by the manufacturer.
- D. Prior to installation, examine each window unit to assure that it is not damaged in any way. Do not install units that are damaged.

3.2 INSTALLATION

- A. In general, strictly comply with manufacturer's printed installation instructions. Refer to the drawings for application sequence for products of this Section.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent Work.
- D. Prior to installing window, install adjustable sill pan flashing.
- E. Insert and center window in opening, adjust as needed to assure unit is completely plumb, level and straight. Operate ventilation sash to assure it

operates properly. Fasten unit as shown on the drawings. Do not fasten the head flange except as noted below.

- F. For units exceeding 24" width, fasten head flange with fasteners placed through washers approximately 3/8" above tops of nail flanges so that washers hold the flange tight to the sheathing while allowing differential header deflection without imposing building loads to the window.
- G. Insert Gutter Guard under the sill flange to promote water drainage under the sill frame. Follow manufacturer's instructions for placement of flange fasteners at the jamb flange and at the sill flange.
- H. Proceed with perimeter flashing installation as shown on the drawings.
- I. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation, or low-expanding foam insulation, in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Coordinate attachment and seal of perimeter air and vapor retarder materials.
- K. Adjust hardware for smooth operation and secure weathertight closure.

3.3 WINDOW AIR LEAKAGE TESTING

- A. The window assembly shall be tested in accordance with ASTM E783-02 (2010) - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
 - 1. The storage room shall be pressurized to 50 Pascal with respect to the exterior.
 - 2. The installation shall be inspected by the Owner with chemical smoke for air leakage of the window installation. This is not a test of the window but of the window installation. The judgment of success of the test will be the approval of the installation by the Owner.
 - 3. The test shall demonstrate that the assembly is substantially airtight with no significant air leakage pathways identified.
 - 4. The installation and test shall be repeated until a satisfactory standard is attained.
 - 5. The successfully tested assembly shall be the method of installation for all the windows in the project.
 - 6. The Owner may test additional windows during the project to ensure compliance. Coordinate with Owner as necessary.

3.4 ERECTION TOLERANCES

- A. ADJUSTING Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non- cumulative or 1/8 inches per 10 ft, whichever is less.

3.5 REMOVING ENERGY-PERFORMANCE LABELS

- A. Remove energy-performance labels from window glass only after the Building Inspector has reviewed and approved the installation.
- B. Carefully remove labels, and provide the General Contractor with three undamaged labels from each separate window type (fixed, single-hung, casement, etc.) for the Project Manual to be provided to the Owner.

3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove protective material from pre-finished surfaces.
- C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.7 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. See section 01 74 19.

END OF SECTION

Safety Vent Latch / Window Opening Control Device Installation Instructions

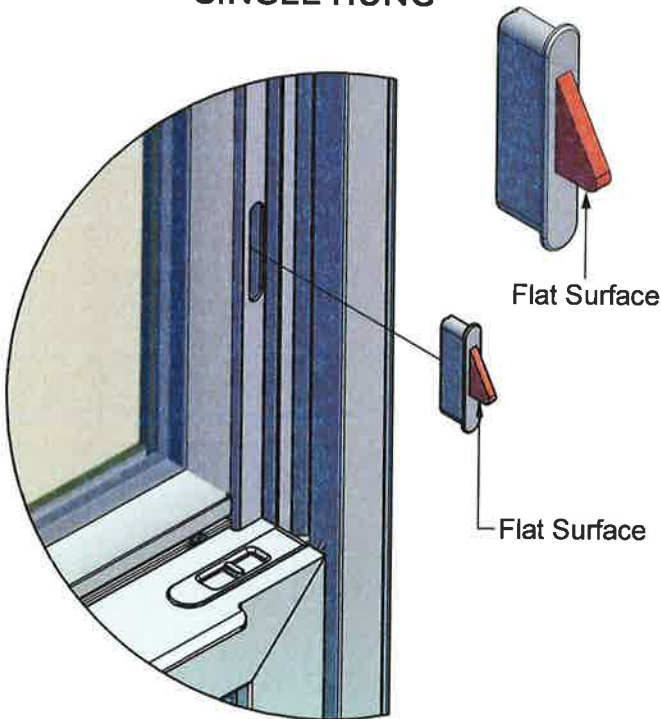


Before you begin...read through all these instructions.

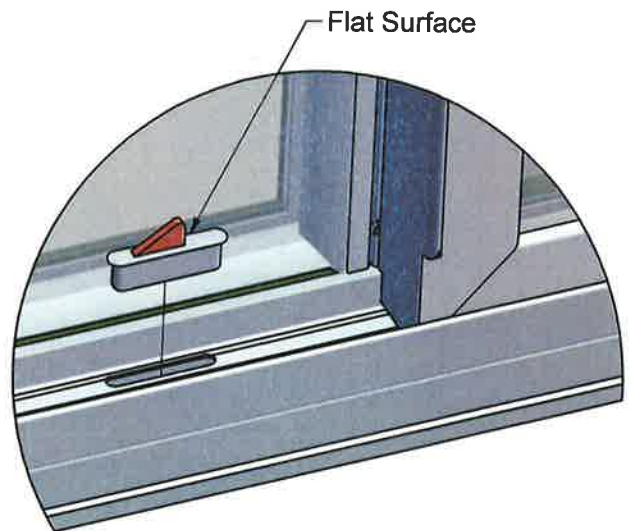
INSTRUCTIONS: Contact local building department or fire department for applicable codes

1. Press the WOCD device into the hole, with the flat surface towards the sash using firm pressure until it snaps in place and is flush with the surface of the frame.
2. SH unit will be on the right jamb above meeting rail.
3. Sliding units will be in the sill of unit.
4. Once latch is placed in the hole push in Orange nose and release, it should return to the extended position.
5. To open sash completely press and hold Orange nose and raise the sash past the latch.
6. To reset latch, close the sash past the latch and it will reset with the orange nose extended out.
7. Fully close and lock the window.

SINGLE HUNG



SLIDER



WARNING

Possible Fall Hazard

- Young children may fall out of the window if the opening control device is not installed correctly.
- Install the device so that a rigid 4.0 in. diameter sphere does not pass through any space in the window opening after the window fall prevention device is in place.
- Young children may fall out of the window if all installation instructions are not followed.
- Use recommended materials and techniques.
- Make sure that the window opening control device is securely attached, as directed, to the window frame.
- Make sure that the window frame is in good condition.



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SECTION 08 71 00

DOOR HARDWARE

GENERAL

1.1 SUMMARY

- A. Work under this section includes the complete finish hardware requirements for the project. Quantities listed are for the contractor's convenience only and are not guaranteed. Items not specifically mentioned, but necessary to complete the work shall be furnished, matching the items specified in quality and finish.
- B. Related Sections:
 - 1. Section 08 16 00 Molded Composite Doors
 - 2. Section 08 16 13 Fiberglass Doors

1.2 QUALITY ASSURANCE

- A. Product Qualification:
 - 1. To assure a uniform high quality of materials for the project, it is intended that only specified items be furnished. Comparable products may be accepted upon prior approval of architect.
 - 2. Hardware to be new, free of defects, blemishes and excessive play. Obtain each kind of hardware (Mechanical latch and locksets, exit devices, hinges and closers) from one manufacturer except where specified.
 - 3. Fire-Rated opening in compliance with NFPA80. Hardware UL10C/UBC-7-2 (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved bearing hinges and smoke seal. Furnish openings complete.
- B. Supplier Qualifications:
 - 1. Hardware supplier will be a direct factory contract supplier who employs a certified Architectural Hardware Consultant (AHC) available at all reasonable times during the course of the work for project hardware consultation to owner, architect and contractor.
 - 2. Supplier will be responsible for detailing, scheduling and ordering of finish hardware.
 - 3. Conduct pre-installation conference at jobsite. Initiate and conduct with supplier, installer and related trades. Coordinate materials and techniques and sequence complex hardware items and systems installation.
 - 4. Key Conference shall be initiated and conducted with owner to determine system, keyway(s) and structure.

C. Installer Qualifications:

1. Installer to have not less than 3 years' experience specializing in installation of work in this section. Company must maintain qualified personnel trained and experienced in installing hardware.

1.3 REFERENCES

- A. NFPA80 – Fire Doors and Windows
- B. NFPA101 – Life Safety Code
- C. NFPA105 – Smoke and Draft Control Door Assemblies
- D. ANSI A117.1 Accessible and Usable Buildings and Facilities

1.4 SUBMITTALS

- A. Hardware schedule: Submit digital copies of schedule. Organize vertically formatted schedule into Hardware Sets with index of doors and headings, indication complete designations of every item required for each door or opening. Include the following:
 1. Type, style, function, size, quantity and finish of hardware items.
 2. Name, part number and manufacture of each item.
 3. Fastenings and other pertinent information.
 4. Explanation of abbreviations, symbols and codes contained in schedule.
 5. Door and frame sizes, materials and degrees of swing.
- B. Product Data: Submit digital copies for each product indicated.
- C. Templates: Obtain and distribute templates for doors, frames, and other works specified to be prepared for installing door hardware.
- D. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1.
- E. Keying Schedule: Prepared by or under the supervision of supplier, after receipt of the approved finish hardware schedule, detailing Owner's final keying instructions for locks.
- F. Samples: Upon request submit material samples.
- G. THE SPECIFICATION WRITER MUST APPROVE ALL SUBMITTALS BEFORE ORDERS CAN BE PLACED.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle and protect products to project site under provisions of Division 1 and as specified herein.

- B. Tag each item or package separately, with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver keys to Owner by registered mail.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
 - a. Closers: Thirty years mechanical, two years electrical
 - b. Exit Devices: Three years mechanical, one year electrical
 - c. Locksets: Ten years(ND), three years (everything else), one year electrical

PRODUCTS

2.1 MATERIAL AND FABRICATION

- A. Provide all door hardware for complete work, in accordance with the drawings and as specified herein.
- B. Provide items and quantities not specifically mentioned to ensure a proper and complete operational installation.

2.2 MANUFACTURERS

- A. Approval of products from manufacturers indicated as "Acceptable Manufacturer" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

ITEM	SCHEDULED MANUFACTURER	ACCEPTABLE MANUFACTURER
Hinges	Ives (IVE)	Hager, Bommer
Flush Bolts & Coordinators	Ives (IVE)	Burns, Rockwood
Locksets & Deadlocks	Schlage (SCH)	No sub.
Aluminum Door Locks - Narrow Style	Adams Rite (ADA)	None
Exit Devices & Mullions	Von Duprin (VON)	No Sub.
Electric Strikes	Von Duprin (VON)	Trine, SDC

Power Supplies	Von Duprin (VON)	No Sub.
Cylinders & Keying	Schlage (SCH)	Everest 29 S keyway
Door Closers	LCN (LCN)	No sub
Automatic Operators	LCN (LCN)	Norton, Besam
Door Trim	Ives (IVE)	Trimco, Burns
Protection Plates	Ives (IVE)	Trimco, Burns
Overhead Stops	Glynn-Johnson (GLY)	Rixson, Sargent
Thresholds & Weatherstrip	Zero (ZER)	NGP, Reese, Pemko

2.3 HANGING

- A. Conventional Hinges: Hinge open width minimum, but of sufficient throw to permit maximum door swing. Steel or stainless steel pins:
1. Three hinges per leaf to 7 feet, 6-inch height. Add one for each additional 30 inches in height or any fraction thereof.
 1. Provide 4 ½ x 4 ½ for 1 ¾" thick doors up to 3'5". Provide 5 x 4 ½ on doors 36" and over.
 2. Exterior outswing doors to have non removable (NRP) pins.
 3. Pin tips, flat button, finish to match leaves
 4. Interior doors over 36" – Heavy weight
 5. Interior doors up to 36" – Standard weight

2.4 LOCKSETS, LATCHSETS, DEADBOLTS

- A. Heavy Duty Mortise Locks and Latches: Schlage L9000 Series
1. Provide mortise locks certified as ANSI A156.13, Grade 1 Operational, Grade 1 Security.
 2. Provide lock case that is multi-function and field reversible for handing without opening case, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
 3. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
 4. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 5. Provide electrified options as scheduled in the hardware sets.
 6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Lever Design: Schlage 06A
- B. Extra Heavy Duty Cylindrical Locks and Latches: Schlage ND Series

1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1.
2. UL listed for A label and lesser class single doors up to 4ft x 8ft.
3. Meets A117.1 Accessibility Codes.
4. Provide solid steel rotational stops to control excessive rotation of lever.
5. Provide completely refunctionable lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
6. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
7. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
8. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
9. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
10. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.

a. Lever Design: Schlage Sparta

C. Standalone Electronic Locksets: Schlage Electronics NDE series

D. Electronic Deadbolt Schlage FE410 series

1. Provide interconnected locksets with electronic deadbolt conforming to ANSI/BHMA A156.12, Grade 2 requirements, with simultaneous retraction of deadbolt and latch for single-operation egress, and certified by UL for 3-hour fire resistance rating.
 2. Provide locks adjustable for 2-3/8 inches (60 mm) or 2-3/4 inches (70 mm) backset with 1/2 inch (13 mm) throw latchbolt and 1-inch throw deadbolt.
 3. Door Thickness: Locksets adjustable to fit in 1-3/8 inches (35 mm) or 1-3/4 inches (44 mm) door thickness.
 4. Strikes shall be standard 1-1/8-inches x 2-3/4-inches square corner strikes, unless extended-lip strikes are required for protection of trim.
 5. Provide AA battery operated interconnected lockset, supporting smart credential technology.
 6. Programming via mobile application through Bluetooth® connection.
 7. Coordinate with door supplier for proper preparation of the unit door. 5 1/2" or 4" center-to-center (CTC) spacing between deadbolt and passage level. Order product accordingly as product is not field reversible.
1. **NOTE:** Hardware supplier is asked to contact Michael Conn, Schlage Multi-Family Consultant, as to coordinate with the general contractor and access control provider to insure a non-proprietary card reader is used. This will ensure the use of the Schlage 9651T MIFARE Smart fob, used on the unit entry locks, can work in both operating systems. If done so, the resident is not required to carry two fobs/credentials in accessing the building and resident unit entry. Coordination with access control provider required to insure compatibility. Recommend the use of Schlage Multi-Technology card readers on common area access control system.

E. ADD FOR TRAINING- 2-hour minimum site training. Coordinate site training with Michael Conn, Schlage Lock.

F. USE ENGAGE SOFTWARE

G. Tubular Locksets: Schlage F Series

1. Provide tubular locks conforming to ANSI A156.2 Series 4000, Grade 2.
2. Provide locks with standard 2-3/8 inches (60 mm) adjustable to 2-3/4 inches (70 mm) backset with 1/2 inch (13 mm) latch throw. Provide 2 3/4 inches (70 mm) backset, unless 2-3/8 inches (60 mm) is required by door or frame detail, or noted otherwise.
3. Provide locksets that fit standard 2-1/8 inches (54 mm) diameter bore without use of thru-bolts.
4. Standard Rose Size: 2-1/2 inches (64 mm) in diameter.
5. Door Thickness: Locksets adjustable to fit in 1-3/8 inches (35 mm) or 1-3/4 inches (44 mm) door thickness.
6. Provide standard T-strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.

a. Lever Design: Schlage ELA

2.5 EXIT DEVICES

A. Panic and Fire Rated Exit Devices: Von Duprin 98/99 Series

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, AND UL listed for Panic Exit or Fire Exit Hardware.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
 - a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-coded to latches and center slides. Conduit and core wire ends snap into latch and center slides without use of tools.
 - b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
 - c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
 - d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
 - e. Product Cycle Life: 1,000,000 cycles.

- f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
 - g. Latch release does not require separate trigger mechanism.
 - h. Cable and latching system characteristics:
 - 1) Assembled prior to being installed in door.
 - 2) Installed in door as complete assembly.
 - 3) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
 - 4) Connected to exit device at single attachment point.
 - 5) Bottom latch height adjusted from single point, after system is installed and connected to exit device, while door is hanging
 - 6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
 - 7) System may be removed while door is hanging.
 - 8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
 - 9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.
- 6. Provide exit devices with manufacturer's approved strikes.
 - 7. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
 - 8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
 - 9. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
 - 10. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
 - 11. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.

2.6 ELECTRIC STRIKES

A. Manufacturers and Products: Von Duprin 6000 Series

- 1. Provide electric strikes designed for use with type of locks shown at each opening.
- 2. Provide electric strikes UL Listed as burglary-resistant.
- 3. Where required, provide electric strikes UL Listed for fire doors and frames.
- 4. Provide fail-secure type electric strikes, unless specified otherwise.

5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

2.7 KEYS, KEYING, AND KEY CONTROL

- A. See Keying Requirements in this section

2.8 CLOSERS

- A. Surface Closers: LCN 4010/4110 Series

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting. Use through bolts to attach closer to door.

- B. Surface Closers: LCN 1460 Series

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action cylinder.
3. Closer Body: 1-1/4 inch (32 mm) diameter, with 5/8 inch (16 mm) diameter heat-treated pinion journal.

4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: not permitted.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting. Use through bolts to attach closer to door.

2.9 OTHER HARDWARE

A. Door stops: Provide stops to protect walls, casework or other hardware.

1. Except as otherwise indicated, provide stops (wall, floor or overhead) at each leaf of every swinging door leaf.
2. Where wall or floor stops are not appropriate, provide overhead holders.

B. Weatherstrip and Gasket

1. Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled.
2. Provide non-corrosive fasteners as recommended by the manufacturer for application indicated.

C. Thresholds

1. Except as otherwise indicated, provide standard metal threshold unit of type, size and profile as detailed or scheduled.

D. Silencers

1. Interior hollow metal frames, 3 for single doors, 2 for pairs of doors.

E. Kickplates

1. Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

2.10 HARDWARE FINISH

A. Provide the following finishes unless noted differently in hardware groups:

Hinges	630 Stainless Steel Exterior, 652 Dull Chrome Interior
Locksets	626 Satin Chrome

Exit Devices	626 Satin Chrome
Closers	689 Aluminum
Kickplates	630 Stainless Steel
Other Hardware	626 Dull Chrome
Thresholds	Aluminum
Weatherstrip/Sweeps	Aluminum

2.11 KEYING REQUIREMENTS

- A. All keyed cylinders shall be subject to a new Schlage Masterkey system.
- B. Furnish cylinders with construction cores. Following construction supply permanent keyed cores.
- C. Cylinders to be furnished with visual key control with key code. Stamped on the face of the keys and marked on the back or side of the cylinders.
- D. Key Quantities
 - 6 EA Master Keys
 - 4 EA Control Keys
 - 2 EA Construction Control Keys
 - 10 EA Construction Keys
 - 3 EA Change Keys per keyed alike group

EXECUTION

3.1 PREPARATION

- A. Ensure that walls and frames are square and plumb before hardware installation.
- B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes. Notify Architect of any code conflicts before ordering materials.

3.2 INSTALLATION

- A. Do not install surface mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation.
- B. Locate floor stops not more than 4 inches from the wall.
- C. Drill pilot holes for fasteners in wood doors and/or frames.

3.3 ADJUSTING

- A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.
- B. Hardware damaged by improper installation or adjustment methods to be repaired or replaced to Owner's satisfaction.

3.4 FOLLOW UP INSPECTION

- A. Installer to provide letter of agreement to Owner that approximately 6 months after substantial completion, installer will visit project with representative of the manufacturers of the locking devices and door closers to accomplish the following:
 - 1. Re-adjust locks and closers
 - 2. Evaluate maintenance procedures and recommend changes or additions, and instruct Owner's personnel.
 - 3. Identify items that have deteriorated or failed.
 - 4. Submit written report identifying problems and likely future problems.

3.5 DEMONSTRATION

- A. Demonstrate electrical, electronic and pneumatic hardware system including adjustment and maintenance procedures











3.6 PROTECTION/CLEANING

- A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion. Clean adjacent wall, frame and door surfaces soiled from installation/reinstallation process.

RESIDENTIAL DOOR HARDWARE GROUPS





Hardware Group No. R01

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER		FINIS	MFR
Y					H	
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	DEADBOLT	BE467F GRW 6 VDC	 ✈	626	SCH
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	SURFACE CLOSER	1461		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	DOOR STOP	060		652	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545A-223		A	ZER
1	EA	VIEWER	U698		626	IVE





Hardware Group No. R02

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER		FINIS	MFR
Y					H	
3	EA	HINGE	5PB1 3.5 X 3.5		652	IVE
1	EA	PASSAGE SET	F10 ELA		626	SCH
1	EA	DOOR STOP	060		652	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE



Hardware Group No. R03

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER		FINIS	MFR
Y					H	
3	EA	HINGE	5PB1 3.5 X 3.5		652	IVE
1	EA	PRIVACY LOCK	F40 ELA		626	SCH
1	EA	DOOR STOP	060		652	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE

Hardware Group No. R04

Provide each SL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER		FINIS	MFR
Y					H	
1	EA	MULTIPLE BYPASS PACK	111MD			JOH
3	EA	FLUSH PULL	221		626	IVE










Hardware Group No. R05

Provide each SL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER		FINIS	MFR
Y					H	
1			HARDWARE BY DOOR / FRAME MANUFACTURER BY SLIDER SUPPLIER			

Hardware Group No. R06 (Rehabilitated Building Utility Access Doors)

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER		FINIS	MFR
Y					H	
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	ND80RD RHO		626	SCH
1	EA	FSIC CORE	23-030 EV29 S		626	SCH
1	EA	SURFACE CLOSER	4111 CUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	RAIN DRIP	142A		A	ZER

Hardware Group No. ENGAGE

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINIS	MFR
1	EA	MULTITECH READER	MT20W	BLK SCE
		ADD FOR SITE TRAINING		
50	EA	CREDENTIAL	9651T	BLK SCE
		CONSTRUCTION		
100	EA	CREDENTIAL	9691T	BLK SCE

COMMUNITY BUILDING – DOOR HARDWARE

HARDWARE GROUP NO. C01

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	PANIC	98-NL-OP-110MD-SNB	626	VON
		HARDWARE			
1	EA	RIM CYLINDER	20-057	626	SCH
1	EA	ELECTRIC STRIKE	6111 FSE 12/24 VAC/VDC	630	VON
1	EA	90 DEG OFFSET	8190HD 12" O	630	IVE
		PULL			
1	EA	OH STOP	100S	630	GLY
1	EA	SURF. AUTO	9542 MS AS REQ (120/240	ANCLR	LCN
		OPERATOR	VAC)		
2	EA	ACTUATOR, JAMB	8310-818T	630	LCN
		MOUNT			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	50AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. C02

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	98-NL-OP-110MD-SNB		626	VON
1	EA	RIM CYLINDER	20-057		626	SCH
1	EA	ELECTRIC STRIKE	6111 FSE 12/24 VAC/VDC	✓	630	VON
1	EA	90 DEG OFFSET PULL	8190HD 12" O		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1		CARD READER - WORK OF DIVISION 28				
1		POWER SUPPLY - WORK OF DIVISION 28				

HARDWARE GROUP NO. C03

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	AL80PD NEP		626	SCH
1	EA	LOCK GUARD	LG12		US32D	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	RAIN DRIP	142AA		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

HARDWARE GROUP NO. C04

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
2	EA	MANUAL FLUSH BOLT	FB358 OR FB458 VERIFY		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	AL80PD NEP		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA ACTIVE LEAF		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS TKTX		630	IVE
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	MEETING STILE	328AA-S		AA	ZER
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. C05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1 5 X 4.5		652	IVE
1	EA	PRIVACY LOCK	L9040 17A L583-363 L283-722		626	SCH
1	EA	SURFACE CLOSER	1461 REG		689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS TKTX		630	IVE
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HARDWARE GROUP NO. C06

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	AL53PD NEP		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65		GRY	IVE



HARDWARE GROUP NO. C07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	ITEMID	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	AL53PD NEP		626	SCH
1	EA	FIRE/LIFE WALL MAG	SEM7850		689	LCN

Hardware Group No. ENGAGE

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MULTITECH READER	MT20W	 ⚡	BLK	SCE
			ADD FOR SITE TRAINING			
50	EA	CREDENTIAL	9651T		BLK	SCE
			CONSTRUCTION			
100	EA	CREDENTIAL	9691T		BLK	SCE

END OF SECTION

RESIDENTIAL REHABILITATED BUILDINGS DOOR HARDWARE INDEX

Legend:

↗ Electrified Opening

Door#	HwSet#
A1 ↗	R01
B1	R02
C1	R03
D1	R02
D2	R02
E1	R04
E2	R04
E3	R04
E4	R04
F1	R05
110	R06
111	R06
ENGAGE ↗	ENGAGE

RESIDENTIAL NEW CONSTRUCTION BUILDINGS DOOR HARDWARE INDEX

Legend:

↗ Electrified Opening

Door#	HwSet#
A1 ↗	R01
B1	R02
C1	R03
D1	R02
D2	R02
D5	R02
E2	R04
E1	R04
E3	R04
E5	R04
E6	R04
F1	R05
110	R06
111	R06
ENGAGE ↗	ENGAGE

COMMUNITY BUILDING DOOR HARDWARE INDEX

Legend:

↗ Electrified Opening

Door#	HwSet#
100 ↗	C01
107	C05
108	C05
109A ↗	C01
109B	MFR.

Door#	HwSet#
109C	MFR.
109D	C02
109E ✎	C07
109F	C02
109G	C04
110A	C04
110B	C04
111	C03
112	C03
113	C06
114	C06
116 ✎	C07
117	C01
117A	C04
119 ✎	C06
120A	C06
120B ✎	C06
121 ✎	C07
ENGAGE ✎	ENGAGE

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings. Also included are shop applied transparent finishes for interior millwork, doors and frames.
- B. The Owner has established sustainability goals for this project. It is a specific requirement of this Section that non-toxic and low-VOC products be used for this project, and that all interior paints, coatings, adhesives and sealants meet specified requirements. It is a specific requirement of this Section that all interior paints and coatings meet the current Green Seal Standards requirements. Refer to Section 01 81 15 & 01 81 19.
- C. Design and performance criteria for this Section regarding health, safety and durability shall take precedence over sustainable design criteria. The Contractor shall inform the Owner and Architect of any conflicts that may result between the noted recycled content and the strength of the materials.
- D. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 06 20 00 - Finish Carpentry.
 - 3. Section 08 16 00 – Molded Composite Doors.
 - 4. Section 08 32 16 - Fiberglass Exterior Doors.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Section 32 17 00 - Pavement Markings / Storm Drain Labels.
- E. Definitions:
 - 1. Conform to ASTM D16 for interpretation of terms used in this section.

1.2 REFERENCES

- A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - 1. ASHRAE Handbook of Fundamentals.
- B. ASTM International:
 - 1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
 - 2. ASTM D913 – Standard Practice for Evaluating Degree of Traffic Paint Line Wear.
 - 3. ASTM D1729 – Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials.
 - 4. ASTM D2369 - Standard Test Method for Volatile Content of Coatings.
 - 5. ASTM D3450 – Standard Test Method for Washability Properties of Interior Architectural Coatings.
 - 6. ASTM D3960 – Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

7. ASTM D4209 – Standard Practice for Determining Volatile and Nonvolatile Content of Cellulosics, Emulsions, Resin Solutions, Shellac, and Varnishes.
8. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
10. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
11. ASTM E2129 – Standard Practice for Data Collection for Sustainability Assessment of Building Products.
- C. Federal Specifications (FS):
 1. TT-P-1952 – Paint, Traffic and Airfield Marking, Waterborne.
- D. National Fire Protection Association (NFPA):
 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
 2. NFPA 286: Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
 3. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- E. PDCA Painting and Decorating Craftsman Manual and Textbook.
- F. SSPC: The Society for Protective Coatings
 1. MPI Architectural Painting Specification Manual
- G. Underwriters Laboratories Inc. (UL):
 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- H. Green Seal: GS-11 Green Seal Environmental Standard for Paints and Coatings.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on finishing products.
- C. Samples:
 1. Submit four painted samples (draw-downs) illustrating selected colors for each color and system selected. Submit on illustration board stock 8x10 inch size.
 2. Submit two samples of wood door veneer with shop-applied transparent finish, 8x10 inch size, illustrating wood grain, stain color and sheen. Refer to Section 08 14 16 and 08 14 33.
- D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, substrate conditions requiring special attention.
- E. VOC Limits: Include manufacturer's literature for each adhesive, coating and sealant used in this Section identifying VOC limits and chemical components. All adhesives must conform to the South Coast Air Quality Management District Rule 1168 and all sealants must conform to Bay Area Air Quality Management District – Regulation 8, Rule 51. All interior paints and primers are required to be Green Seal certified under the current Green Seal Standards.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics: Fire Retardant Finishes: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Applicators: Company specializing in performing work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.9 SEQUENCING

- A. Section 01 10 00 – Summary: Work sequence.
- B. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied.
 - 2. Back prime wood trim before installation of trim.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Quantity: **None required.**

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Listed Manufacturers: Interior Paint: Sherwin Williams.
- B. Other Manufacturers:
 - 1. Benjamin Moore.
 - 2. Pratt & Lambert.
 - 3. Rodda Paints.
 - 4. The Glidden Co.
 - 5. Substitutions: Section 01 25 13 – Product Substitution Procedures.
- C. Listed Manufacturers: Exterior Paint: Rodda.
- D. Other Manufacturers:
 - 1. Benjamin Moore.
 - 2. Pratt & Lambert.
 - 3. Sherwin Williams.
 - 4. The Glidden Co.
- E. Substitutions: Section 01 25 13 – Product Substitution Procedures
- F. Listed Manufacturers: Traffic Coating (at balconies): ArmorThane STS-300, Rhino Linings TuffGrip.

2.2 COMPONENTS

- A. Coatings: Ready mixed, except field-catalyzed coatings. Prepare coatings:
 - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.
- B. Low VOC content: required for all interior applications. Refer to limits in Section 01 81 15, & 01 81 19.
- C. Vapor-Retarder requirements for primer and topcoats, exterior wall assemblies: products shall be vapor semi-permeable, ASHRAE Class II, 1.0 perm or less and greater than 0.1 perm. (Do not provide if spray foam insulation is installed at exterior walls.)
- D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- E. Patching Materials: Latex filler, Low-VOC (GS 11).
- F. Fastener Head Cover Materials: Latex filler, Low-VOC (GS 11).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate conditions are ready to receive Work as instructed by product manufacturer.

- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent measured in accordance with ASTM F2659.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent measured in accordance with ASTM F2659.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors: 8 percent measured in accordance with ASTM F2659.

3.2 PREPARATION

- A. Surface Appurtenances: Remove [or mask] electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- G. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- H. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high-pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- I. Copper Surfaces Scheduled for Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.
- J. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- K. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- L. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

- M. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- N. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- O. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- P. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- Q. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- R. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.
- S. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.
- T. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with tinted primer.
- U. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. Sand wood and metal surfaces lightly between coats to achieve required finish.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- F. Prime concealed surfaces (back-prime) of interior and exterior woodwork with primer paint.
- G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.
- H. Finishing Mechanical And Electrical Equipment (exposed to view in the finished work):
 - 1. Paint shop primed equipment.

2. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
3. Prime and paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, with the exception of shop finished items or specifically noted to be left unpainted.
4. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, to match face panels.
5. Paint exposed conduit and electrical equipment occurring in finished areas.
6. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and/or numbering.
7. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- I. Do not apply finishes to the following materials:
 1. Metals as listed: brass, bronze, copper, plated metals, stainless steel, anodized aluminum.
 2. Acrylic wall coverings.
 3. Materials having a complete factory finish including: electrical switch plates, lighting fixtures, and finish hardware.
 4. Finished cabinets.
 5. Pre-finished wood.
- J. Place used sealant tubes and near empty containers in areas designated for hazardous materials.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Collect waste material that may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.5 SCHEDULE – SHOP FINISHED ITEMS

- A. See 05 50 00 - Metal Fabrications and 05 52 00 - Metal Railings for shop finishes associated with exterior metal stairs.

3.6 SCHEDULE – **EXTERIOR SURFACES**

- A. General Prep:
 1. Caulk all splits and cracks. Press all caulking into gaps using a finger or appropriate tool. Use the specified patching compound for gaps exceeding 1/4 inch. Refer to manufacturer's printed instructions for further instructions regarding caulking or patching compounds. Caulking shall be carefully completed and, if necessary, trimmed and smoothed to provide a uniform surface.
 2. Caulking: Sashco Big Stretch Caulk.
- B. Priming:
 1. All unprimed areas (except metal): Rodda 501601x First Coat Primer.

2. All rust and unprimed metal with: Rodda 70822x Barrier III High Solids Metal Primer.
3. No primer over wood fencing.
- C. Fiber Cement Panel / Lap Siding and Trim:
 1. Rodda 521101x AC909 Satin
 2. Follow fiber cement siding manufacturer's printed painting instructions.
 3. Apply by sprayer, brush and roll, 2 coats to all surfaces to be painted, minimum dry film thickness of 1.5 mils (4 mils wet).
- D. Door and Wraps:
 1. Rodda 542001x Unique II Semi-Gloss..
 2. Apply 2 coats. Additional coats may be required, minimum dry film thickness of 1.5 per coat, 4 mils wet per coat
- E. Wood Fencing:
 1. Cloverdale 06680 WeatherOne Semi-Transparent 100% Acrylic Stain
 2. Apply 1 coats to cover, spray & back roll using.

3.7 SCHEDULE – **INTERIOR SURFACES**

- A. Fiberglas Entry Door and Millwork:
 1. One coat: Sherwin Williams B51W00620 PrepRite ProBlock Int/Ext Latex Primer/Sealer MPI#6
 2. Two coats: Sherwin Williams A76W00051 SOLO Int/Ext 100% Acrylic, Semi-Gloss MPI#54.
- B. Wood Door and Trim
 1. One coat: Sherwin Williams B51W00620 PrepRite ProBlock Int/Ext Latex Primer/Sealer MPI#6.
 2. Two coats: Sherwin Williams A76W00051 SOLO Int/Ext 100% Acrylic, Semi-Gloss MPI#54.
- C. Gypsum Board Walls and Ceilings:
 1. One Coat: Sherwin Williams B51W08670-Quick Dry Int/Ext Stain Blocking Primer MPI#149.
 2. One Coat: Sherwin Williams B20W03050-Property Solutions Int Latex Eggshell.
 3. Walls and Ceilings: Coats to cover, spray and backroll in all units and laundry rooms.
- D. Bathrooms and Kitchens:
 1. One Coat: Sherwin Williams B31W3060-Property Solutions Int Latex Semi-Gloss.
 2. Additional mildew control additive - Trimaco Mildew Control (Solar Chemicals)

3.8 SCHEDULE - **COLORS**

- A. For exteriors, allow up to **three (3)** building color schemes. For each building color scheme, allow **three (3)** total primary paint colors (**9 colors total**). Each building color scheme will use **one (1)** total color for exterior trim.
- B. For interiors, allow up to **two (2)** primary paint colors and up to **two (2)** accent paint colors per building. Verify through submittal process; colors selected by Architect/Owner.

3.9 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Set aside extra materials for reuse by Owner. Materials not required by the Owner should be donated to non-profit organizations (such as Habitat for Humanity or other similar programs) where feasible.
- B. Where possible, give preference to suppliers who take back waste for re-use or recycling.
- C. Determine local options for recycling, collect all remaining unused materials by type and transport to a legitimate recycling facility.
- D. Close and tightly seal all partly used adhesive or sealant containers, and store protected in well-ventilated, fire-safe area at moderate temperature.
- E. Place used sealant tubes and near empty containers in areas designated for hazardous materials.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes installing Owner-provided contractor-installed exterior and interior non-illuminated signs and contractor-provided and installed site signage.
- B. The Owner has established sustainability goals for this project, and this Section contains specific information and requirements for compliance. Refer to Section 01 81 15 for specific requirements.
- C. It is a specific requirement of this Section that non-toxic and low-VOC products be used for this project, and that all interior adhesives and sealants meet specified requirements. Refer to Section 01 81 15 & 01 81 19.
- D. Design and performance criteria for this Section regarding health, safety and durability shall take precedence over sustainable design criteria. The Contractor shall inform the Owner and Architect of any conflicts that may result between the noted recycled content and the strength of the materials.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Info: Product information for method of attachment for interior signs.
- C. VOC Limits: Include manufacturer's literature for each adhesive, coating and sealant used in this Section identifying VOC limits and chemical components.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.
- C. Store adhesive products at ambient room temperatures.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 EXTERIOR AND INTERIOR SIGNS

1. Owner provided. Contractor installed.

2.2 MATERIALS – SITE SIGNS – Contractor supplied and installed.

- A. **Sign Type A:** Accessible parking signs: located in walks at designated vehicle stalls.
- B. Mounting Locations: Refer to drawings for mounting requirements. Where location is not specifically identified on drawings, contact Architect for direction. Review location of all signs prior to installation with Architect.
- C. **Sign Type AA:** Electric Vehicle parking signs: located in walks at designated electric vehicle charging stalls. Signage to read as follows:

CHARGING
STATION
ELECTRIC
CAR PARKING
ONLY WHILE
CHARGING

2.3 MATERIALS – EXTERIOR SIGNS – Owner supplied. Contractor installed.

- A. **Sign Type B:** Typical exterior building & address identification placards: Raised characters on acrylic face. Mounting on 1/4" projected spacers. Two signs for each building at locations. Verify locations with Owner/Architect.
 1. *Example:* A 3015
 2. See G001 for building number and address
- B. **Sign Type C:** Typical exterior building & address identification placards: Raised characters on acrylic face. Mounting on 1/4" projected spacers. One sign for each building/stair entry. Verify locations with Owner/Architect.
 1. *Example:* UNITS 1-16,
 2. See A101-A103 for unit numbers
- C. **Sign Type D:** Typical exterior building & address identification placards: Raised characters on acrylic face. Mounting on 1/4" projected spacers. One sign for each building entry. Verify locations with Owner/Architect.
 1. ELECTRICAL ROOM
 2. WATER SERVICE ROOM
 3. DOMESTIC HOT WATER PLANT
 4. DHWP CONDENSERS

2.4 MATERIALS – INTERIOR SIGNS - ~~Owner supplied.~~ Contractor supplied and installed.

- A. **Sign Type E:** Typical apartment unit numbers: Provide Gatehouse 3.86" satin nickel unit numbers at entry door to each unit. Adhesive mounting. Number scheme per building as indicated on drawings.
- B. **Sign Type F:** Maximum Occupancy Signage at Community Room of Community Building: Provide Gatehouse 3.86" satin nickel unit numbers at entry door to each unit. Adhesive mounting. Number scheme per building as indicated on drawings.

- C. **Sign Type G:** Instructional signage adjacent to range. To be mounted at backsplash as shown interior elevation drawings. Adhesive mounting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 INSTALLATION

- A. Install signs after doors are installed and wall surfaces are finished, in locations directed.
- B. Secure all items with tamperproof fasteners recommend by manufacturer and as specified.
- C. Set level, plumb, and at the height indicated. Mounting surface shall be free from distortion or other defects in appearance.
- D. If installation is on glass relites, install with double-backed foam tape on interior glass relite surfaces with a matching base plate for the reverse of the glass to hide tape.

3.3 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Set aside extra materials for reuse by Owner. Materials not required by the Owner should be donated to non-profit organizations (such as Habitat for Humanity or other similar programs) where feasible.
- B. Where possible, give preference to suppliers who take back waste for re-use or recycling.
- C. Determine local options for recycling, collect all remaining unused materials by type and transport to a legitimate recycling facility.
- D. Close and tightly seal all partly used adhesive or sealant containers, and store protected in well-ventilated, fire-safe area at moderate temperature.
- E. Place used sealant tubes and near empty containers in areas designated for hazardous materials.
- F. Collect cut-offs and scraps and place in designated area for recycling.

END OF SECTION

SECTION 10 57 23

CLOSET AND UTILITY SHELVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes supplying and installing miscellaneous interior and exterior specialties.
- B. The Owner has established sustainability goals for this project, and this Section contains specific information and requirements for compliance. Refer to Section 01 81 15 for specific requirements.
- C. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 09 21 16 - Gypsum Board Assemblies.
 - 3. Section 09 90 00 - Painting and Coatings.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 6. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - 7. ASTM C1036 - Standard Specification for Flat Glass.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on specialty products describing size, finish, details of function, attachment methods.
- C. Samples: Submit four samples of each specialty product where Architect is required to make a finish selection, illustrating color and finish choices.
- D. Manufacturer's Installation Instructions: Submit special procedures, and conditions requiring special attention.
- E. VOC Limits: Include manufacturer's literature for each adhesive, coating and sealant used in this Section identifying VOC limits and chemical components. All adhesives must conform to the South Coast Air Quality Management District Rule 1168 and all sealants must conform to Bay Area Air Quality Management District – Regulation 8, Rule 51, if applicable.

- F. Submit certification from manufacturer stating the percentage of recycled content material, identifying post-consumer and post-industrial contents, if applicable.
- G. Submit certification from manufacturer verifying the location of the manufacturer, including full address and phone number, and list of materials harvested, extracted or recovered within 500 miles of the project site, if applicable.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with placement of internal wall reinforcement.

PART 2 PRODUCTS

2.1 INTERIOR SPECIALTIES, MANUFACTURERS AND MODEL NUMBERS

- A. Manufacturer and/or product model substitutions: Section 01 25 13 – Product Substitution Procedures.
- B. **Closet shelving**; Locations and number shown on drawings. Coated steel wire closed mesh shelving, nominal 12" deep with coat hanger rod under shelf where noted, ClosetMaid or approved equal. All shall be adjustable to 42"-60" above finished floor (ESDS 1.2). At all bedroom closets equal to or greater than 60" wide at the interior provide a 5 shelf, 12" wide shoe rack. Install all shelves with wall brackets, end caps, hold-down clips and other accessories standard with the manufacturer for a complete installation. Provide solid blocking behind.
- C. **Bathroom shelving**; Locations and number shown on drawings. Coated steel wire closed mesh shelving, nominal 12" deep, ClosetMaid or approved equal. Install with wall brackets, end caps, hold-down clips and other accessories standard with the manufacturer for a complete installation. Provide solid blocking behind.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify exact location of products for installation.
- C. Verify field measurements are as indicated on product data submittal.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Install plumb and level, securely and rigidly anchored to substrate.
- B. Follow manufacturer's printed instructions, using manufacturer's standard attachment devices and procedures.
- C. Adjust all moving parts to operate smoothly.

- D. Leave product and adjacent area clean and free of defects.

3.4 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Refer to Section 01 74 19 for specific requirements.

END OF SECTION

SECTION 10 55 26

PARCEL LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Luxer One smart locker system includes metal lockers with electronically controlled enclosures. Lockers are controlled and managed by proprietary software.

1.2 RELATED SECTIONS

- A. Section 055000 - Metal Fabrications: Metal anchors.
- B. Section 123100 - Manufactured Metal Casework.
- C. Section 260500 - Building Electrical.
- D. Section 42356.1 - Plastics and Rubber

1.3 REFERENCES

- A. ASTM A653/A653M - 19a Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed)
- B. ASTM A240 - Specification for Austenitic Metal Sheet, Strip, Plate and Flat Bar.
- C. ASTM A1008 - Specification for Steel, Sheet Cold-Rolled, Carbon, Structural High Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
- D. ASTM B209 - Specification Aluminum and Aluminum Alloy Sheet and Plate.
- E. ASTM B221 - Specification Aluminum and Aluminum Alloy Extruded Bar, Rods, Wire, Shapes, and Tubes.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Locker product information can be found at:
<http://info.luxerone.com/download-package-locker-specifications>
- C. CAD Illustrations: Created for each individual project; show dimensions of locker system, wall lengths and depth, and interface with other products.
- D. Elevation Illustrations: Indicate locker component profiles, elevations, finishes, and accessories.
- E. Closeout Submittals: i) Manuals for installation and maintenance are provided upon request and at the time of installation. ii) Manufacturer warrants the equipment and system to be free of material manufacturer defects for a term of 1 year. Metal locker components are covered by a 1 (one) year manufacturer's warranty from the date of delivery. Damage

caused by vandalism, excessive wear and tear or adverse weather conditions are not covered by the warranty.

1.5 SCHEDULING

- A. Ordering: Orders are placed through manufacturer's sales department.
- B. Delivery: Manufacturer will deliver in original packaging. Customer to inspect for damage and accept at time of delivery.
- C. Storage: Products are delivered and stored in a dry, well-ventilated area until ready for installation.
- D. Handling: Lockers to be handled in a way to prevent damage or scuffing of the finished product.
- E. Installation: Luxer One project management representative will coordinate delivery and installation to location as arranged in advance with customers.

1.6 REGULATORY REQUIREMENTS

- A. Comply with Accessibility Guidelines of the Fair Housing Act (www.fairhousingfirst.gov). Both hardware and software designs include high / low reach minimums. Reach out to Luxer One for regulatory sections on compliance.
- B. Comply with UL-Standard-60950-1:2007-R (TUV Safety Standard Spec).

1.7 QUALITY ASSURANCE

- A. Installation Qualifications: All installations are coordinated by Luxer One. Luxer One uses authorized installers.
- B. Manufacturer Qualifications: All Luxer One manufacturers are ISO 9001:2008 certified with quality assurance practices in place.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
Sales Office: Luxer One, 5665 Power Inn Road, Suite 140, Sacramento, California, 95825
Manufacturing Operations: Roseville Precision Inc. 1180 Tara Court, Rocklin, California, 95765
Tel: (415) 390-0123
Email: installs@luxerone.com
Web: <https://www.luxerone.com/>
- B. Substitutions: Not permitted.

2.2 ELECTRONIC LOCKER SYSTEM

- A. Luxer One smart locker system includes one touchpad in each main unit.

Additional lockers may be connected and controlled from the main unit touchpad. Each system comes with a variety of compartment sizes and more information may be found by reviewing the Luxer Specification Sheet.

- B. Luxer One Lockers are 76" high (unleveled), 37.5" wide and 23" deep (unless otherwise noted).

- (1) Luxer One 15-Door Main Locker – (indoor use) features:

- 15 compartments.
- Touchscreen.
- Battery back-up.
- Surge protection and electronics.
- One main unit is required with every installation.
- Weight 500 lbs.

- (1) Luxer One 17-Door Add-On Locker (indoor use) features:

- 17 compartments, ranging in size (small, medium, and large).
- Add as many as you need.
- Weight: 500lbs

Other Luxer One Lockers include:

- (1) 14-Door, All-Medium, 14 compartments, 500 lbs.
- (1) 4-Door Add-On, 4 compartments, 350 lbs.

1. All of the above lockers are available for outdoor use by adding a Luxer One Roof Kit (50 lbs), Camera Kit and Outdoor Footings (Exception: Sightline models)
2. Compartments are indicated on associated plan. Compartment identification is managed by software. Each compartment is equipped with electronic solenoid lock.
3. Locker Module Materials:
 - A. Compartment Doors: Galvannealed Steel (ASTM A653-653M-19A)
 - B. Framing: Galvannealed Steel (ASTM A653-653M-19A)
 - C. Interior Shelves: Galvannealed Steel (ASTM A653-653M-19A)
 - D. Cabinet: Galvannealed Steel (ASTM A653-653M-19A)
 - E. Latch Hooks: 301 Stainless Steel (ASTM A240)
4. Locker System Base Materials:
 - A. Galvannealed Steel (ASTM A653-653M-19A)
5. Kiosk Module includes the following electronic components:
 - A. Touchscreen (iPad GEN3 or later)
 - B. Camera (video and data storage recorder)
 - C. Router
 - D. Power Supply
 - E. Battery Backup

- F. Control Board Assembly
- G. GFCI Adapter (outdoor only)
- H. Thermoelectric Cooling Unit (outdoor only)

- 6. Finishes:
 - A. Silver (RAL 9006) (Default for outdoor systems)
- 7. Mounting:
 - A. Floor mounting outdoor options: provided within kit for system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Site Survey:
 - i. Check for active ethernet and power.
 - ii. Check for adequate clearance and pathway to install area.
 - iii. Confirm dimensions to floor plan.
 - iv. Ensure floor is level for installation.

3.2 INSTALLATION

- A. Install Luxer One Lockers in accordance to shop drawings and installation guides.
- B. Lockers shall be level and adjusted in accordance to installation spec guides.
- C. Alcove installations shall require a minimum clearance of 2 inches around the sides of the lockers and 3 inches between the lockers and back wall of alcove.
- D. For nominal temperatures for both indoor and outdoor systems, refer to temperature and humidity sections on Spec Sheet.

3.3 COMMISSIONING

- A. Locker systems shall be tested at manufacturer and during initial installation.

3.4 CLEANING

- A. Refer to Luxer One General Cleaning Guide.

3.5 PROTECTION OF INSTALLED PRODUCTS

- A. Protect installed product until completion of installation or project. Touchup, repair, and replace damaged product until completion of the project.

END OF SECTION

SECTION 11 31 00

APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Work includes but is not limited to residential kitchen as shown on drawings, including Owner-provided Contractor-installed appliances.
- B. The Owner has established sustainability goals for this project, and this Section contains specific information and requirements for compliance. Refer to Section 01 81 15 for specific requirements.
- D. Design and performance criteria for this Section regarding health, safety and durability shall take precedence over sustainable design criteria. The Contractor shall inform the Owner and Architect of any conflicts that may result between the noted recycled content and the strength of the materials.
- E. Related Sections:
 - 1. Section 12 35 30 – Casework.
 - 3. Division 26 – Electrical.

1.2 SUBMITTALS

- A. Section 10 33 00 - Submittal Procedures: Submittal procedures.
- B. Setting drawings: Provide setting drawings showing all installation conditions for built-in equipment.
- C. Product data: Submit copies of manufacturer's product data, installation, and maintenance instructions for each appliance. Transmit extra copies of installation instructions to installer.
- D. Provide templates, instructions, and directions required to insure accurate location of utility rough-in and anchorage devices.
- E. Operation and Maintenance Data per Section 01 70 00: Submit in triplicate manufacturer's printed directions.

1.3 QUALITY ASSURANCE

- A. Section 01 41 00 - Regulatory Requirements: See referenced codes, ordinances, and the like.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements.
- B. Carefully crate and insulate against marring, and other damage in transit.
- C. Acceptance at site: Carefully uncrate. Verify units in satisfactory condition.
- D. Store out of harm's way. Handle units carefully, prevent marring. Protect units at all times.

1.5 SERVICE AND WARRANTY

- A. Fully guarantee each unit against defects in function and appearance (not

caused by abuse) for a period of two years minimum (or longer if standard with manufacturer) from date of Substantial Completion.

- B. Remove, reinstall new units, transport, furnish parts, labor and any other service or material necessary to correct defective units. All appliances are to be in perfect operating condition.
- C. Supplier to be in position to offer service contract after warranty expiration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Listed Manufacturer: GE, unless otherwise noted.
- B. Substitutions: Section 01 25 13 – Product Substitution Procedures.
- C. Provide all product types from the same Manufacturer for consistency and uniformity.
- D. Submittal package shall indicate manufacturer's current model number if different than the model listed.
- E. Color: white unless otherwise indicated.

2.2 DWELLING UNIT AND OFFICE KITCHEN APPLIANCES

- A. Owner-Provided and Contractor Installed ~~and Installed, N.I.C.:~~
 - 1. ADA Oven/Range: GE # JBS460DMWW – **Unit D**
 - a. 30" wide free-standing electric range.
 - b. ADA compliant.
 - 2. Oven/Range: GE # JB256DMWW - **Units**
 - a. 30" wide free-standing electric range.
 - 3. Refrigerator/Freezer: GE # GTE16DTNRWW - **Units**
 - a. Top-freezer refrigerator, white finish, 15.5 cu.ft.
 - b. Energy Star labeled.
 - c. ADA compliant.
 - 4. ADA Washing Machine: GE # GFW148SSMWW – **Unit C**
 - a. Front loading.
 - b. Energy Star labeled.
 - c. ADA compliant.
 - 5. ADA Dryer: GE # GFD14ESSNWW – **Unit C**
 - a. Front loading.
 - b. Energy Star labeled.
 - c. ADA compliant.
 - d. Long vent.
 - 6. Washer/Dyer Stack: GE # GUD27EESNWW – **Units**
 - a. Energy Star labeled.
 - b. Long vent.
 - 7. Dishwashers: GE # GDT550PGRWW – Units
 - a. Energy Star labeled.
- B. Contractor Provided and Installed:
 - 1. Range hood: ~~Air King ESDQ1308 – Units~~ Broan 30" Ducted Model Number 423001

1. 30" wide, white finish, LED lamp.
2. Energy Star labeled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to all work of this section, carefully inspect work of all other trades and verify conditions as complete and satisfactory for appliance installation.
- B. Verify that equipment may be installed in accordance with original design and manufacturer's recommendations.
- C. Discrepancies: In the event of discrepancy, immediately notify Architect. Do not proceed until all discrepancies have been fully resolved.

3.2 INSTALLATION, POSITION

- A. Install in accordance with all referenced regulation requirements and manufacturer's directions.
- B. Deliver self-supporting units to room.
- C. Set in location indicated, level, and properly align with casework and other fixtures.
- D. Secure as necessary.
- E. Check operation. Appliances are to be in perfect operating condition. Remove all packing, paper wrapping, etc. prior to operating each appliance.
- F. Arrange for and coordinate electrical and mechanical connections as applicable.
- G. Arrange for and coordinate electrical and mechanical connection as applicable. Ranges shall sit flush against back walls – coordinate with Division 26 work & the installation of timer related equipment to assure that flush installation is achieved.

3.3 FIELD QUALITY CONTROL

- A. Conduct inspection and tests of equipment in presence of Architect.
- B. Remove, transport, reinstall, furnish parts, labor and any other service or material necessary to replace defective units.

3.4 ADJUSTMENTS AND CLEANING

- A. Adjust unit as required for proper operation.
- B. Leave installations clean; premises free from residue of work of this section.

3.5 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Set aside extra materials for reuse by Owner. Materials not required by the Owner should be donated to non-profit organizations (such as Habitat for Humanity or other similar programs) where feasible.
- B. Where possible, give preference to suppliers who take back waste for re-use or recycling.
- C. Determine local options for recycling, collect all remaining unused materials by type and transport to a legitimate recycling facility.

- D. Close and tightly seal all partly used adhesive or sealant containers, and store protected in well-ventilated, fire-safe area at moderate temperature.
- E. Place used sealant tubes and near empty containers in areas designated for hazardous materials.
- F. Collect cut-offs and scraps and place in designated area for recycling.

3.6 PROTECTION OF INSTALLED WORK

- A. Protect installed units against damage and deterioration during remainder of construction period.

END OF SECTION

SECTION 12 35 30

CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes modular cabinets and cabinet hardware in apartment kitchens.
- B. The Owner has established sustainability goals for this project, and this Section contains specific information and requirements for compliance. Refer to Section 01 81 15 for specific requirements.
- C. It is a specific requirement of this Section that non-toxic and low-VOC products be used for this project, and that all interior paints, coatings, adhesives and sealants meet specified requirements. Refer to Section 01 81 15 & 01 81 19.
- D. Design and performance criteria for this Section regarding health, safety and durability shall take precedence over sustainable design criteria. The Contractor shall inform the Owner and Architect of any conflicts that may result between the noted recycled content and the strength of the materials.
- E. Related Sections:
 - 1. Section 12 36 61.16 – Solid Surface Countertops.
 - 2. Section 09 68 16 – Resilient Flooring.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.9 - Cabinet Hardware.
 - 2. ANSI A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets.
- B. Kitchen Cabinet Manufacturers Association: KCMA - Directory of Certified Cabinet Manufacturers.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate casework locations, scale plans, elevations, rough-in and anchor placement dimensions and tolerances, and clearances required. Provide plan and elevation drawings based on as-built room dimensions and indicate any filler panel location and sizes required.
- C. Product Data: Submit component dimensions, configurations, construction details, joint details, and standard hardware.
- D. Samples: Submit fully finished sample, including face frame, door and drawer fronts and hardware, including stain color finish options.
- E. Urea Formaldehyde: Include manufacturer's literature stating that no cabinetry components contain added urea formaldehyde.
- F. VOC Limits: Include manufacturer's literature for each adhesive, coating and sealant used in this Section identifying VOC limits and chemical components. All adhesives must conform to the South Coast Air Quality Management District

Rule 1168 and all sealants must conform to Bay Area Air Quality Management District – Regulation 8, Rule 51.

- G. Submit certification from manufacturer verifying the location of the manufacturer, including full address and phone number, and list of materials harvested, extracted or recovered within 500 miles of the project site.
- H. Provide certification from manufacturer verifying the location of the fabricator for products of this Section. Include mailing address and phone number. Provide list of recovered or recycled steel within 500 miles of project site.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ANSI A161.1 and KCMA certification.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.6 WARRANTY

- A. Provide manufacturer's 5-year warranty on cabinets and limited lifetime warranty on drawer box, drawer guides and hinges.

PART 2 PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Specifications are based on Aristokraft Cabinetry, Jasper, IN for all residential area cabinets. Other manufacturer's offering products meeting requirements are:
 - 1. Canyon Creek, Monroe, WA.
 - 2. Markay Cabinets Inc., Poulsbo, WA
 - 3. Substitutions: Section 01 25 13– Product Requirements

2.2 MATERIALS AND CONSTRUCTION FOR WOOD CABINETS

- A. All materials/products to have no added urea formaldehyde (NAUF).
- B. Finished Surfaces: All exposed ends and sides shall have matching material and finish. Cabinets with adjacent removable cabinets or self-supporting appliances shall have an adjacent finished side to allow for removal. Finished exteriors are factory hand-wiped stain, spray lacquer seal coat and catalyzed lacquer finish coat.
- C. Cabinet Box: Sides, tops and bottoms from 3/8" and 1/2" plywood with birch veneer interior finish with natural UV finish and hardwood veneer exposed exterior.
- D. Wood species and finish: Per finish schedule.
- E. Refer to cabinet elevations on drawings.
- F. Shelves: 3/4" thick white laminate. Adjustable by the use of metal pegged shelf clips with holes at 2" o.c. Provide 200 extra clips for Owner's stock.

- G. Drawer Guides: 7/8 extension, 100 lb. load capacity. Epoxy coated white finish; one-sided captive guide rail; integrated self-closing feature, double STOP and rollout prevention; noise absorbing plastic rollers, brushed bearings.
- H. Cabinet Doors and Drawer Fronts: Solid slab drawer fronts, 3/4" solid door rail and flat veneer center panel.
- I. Door Style: *Benton*, Shaker style.
- J. Drawer Box: Screwed to drawer front. Sides, front and back from 3/4" birch wood, dovetail joint. Bottom from 1/4" plywood.
- K. Box, shelf and drawer construction to meet referenced standards.
- L. Hinges: Self-closing, fully adjustable, concealed hinges; opening angle 110°.
- M. Pulls: Provide Liberty 1-1/4" satin nickel, round solid knobs on doors and drawers. Typical in units.
- N. Door Bumpers: Resilient plastic with adhesive back; clear color; 5/16" diameter x 3/64".
- O. Cabinet construction to be a minimum 25% recycled content post-consumer.

2.3 COUNTERTOPS

Refer to Section 06 61 16.

2.4 APPLIANCES

Appliances are supplied under Section 11 31 00. Coordinate cabinet design and installation to accommodate size and location of appliances shown.

2.5 LOCATIONS

See architectural interior elevations.

2.6 FABRICATION

- P. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- Q. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
- R. Fabricate each unit rigid, not dependent on building structure adjacent units for rigidity.
- S. Form edges smooth. Form material for counter tops from continuous sheets.
- T. Provide cutouts for plumbing fixtures and appliances. Prime paint contact surfaces of cut edges.
- U. When necessary to cut and fit on site, furnish materials with ample allowance for cutting. Furnish trim for scribing and site cutting.
- V. Exposed To View Surfaces and colors: selected by the Architect from the manufacturer's standard finish choices.
- W. Interior Surfaces: manufacturer's standard vinyl/melamine surfacing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify adequacy of support framing.

3.2 INSTALLATION

- A. Install casework, components and accessories.
- B. Use anchoring devices to suit conditions and substrate materials encountered.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Use filler strips; not additional overlay trim for this purpose.
- E. Close ends of units, back splashes, shelves and bases. Joints between units to be tight and flush.
- F. Sealants: Refer to Section 07 90 00 for type. Apply continuous bead of clear sealant at top of countertop splash-to-wall.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

3.5 CABINET INSTALLATION

- A. Install cabinets to be true, level and plumb. Install in complete compliance with manufacturer's printed instructions.
- B. Fasten adjacent cabinets with manufacturer's installation screws through face frame edges (pre-drill). Joints between cabinets to be tight and flush.
- C. Fit tight to walls and anchor to wall studs or solid blocking as prescribed by the manufacturer from interior of unit.
- D. Closure strips to be scribed accurately to wall surface -- any gaps to be filled with sealant -- specified in Section 07 90 00.
- E. Adjust all hardware to proper function and fit.

3.6 COUNTERTOP INSTALLATION

- A. Attach countertops securely to base cabinets with continuous bead of construction adhesive applied to cabinet top frame stiffeners. Apply hand pressure or clamp to seat and screw from underside through cabinet frame into top.
- B. Where joining more than one section or where mitering sections, apply carpenter's glue to both edges and draw panels together using 3 or more 3" minimum x 1/4" countertop drawbolts. Drawbolts are to be recessed into routed slot in underside of countertop.

- C. Factory-made tops shall be mitered and joined accurately. Any minor gapping shall be filled with a matching seam filler
- D. Provide cutouts for fixtures and appliances as indicated - seal penetrations (cut edges).
- E. Install sealant at top of splash to wall. Sealant specified in Section 07 90 00.

3.7 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Set aside extra materials for reuse by Owner. Materials not required by the Owner should be donated to non-profit organizations (such as Habitat for Humanity or other similar programs) where feasible.
- B. Where possible, give preference to suppliers who take back waste for re-use or recycling.
- C. Determine local options for recycling, collect all remaining unused materials by type and transport to a legitimate recycling facility.
- D. Close and tightly seal all partly used adhesive or sealant containers, and store protected in well-ventilated, fire-safe area at moderate temperature.
- E. Place used sealant tubes and near empty containers in areas designated for hazardous materials.
- F. Collect cut-offs and scraps and place in designated area for recycling.

3.8 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean casework, counters, shelves, and hardware.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit finished casework to be exposed to continued construction activity.

END OF SECTION

SECTION 12 36 61.16

SOLID SURFACING COUNTERTOPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes solid surface countertops.
- B. Related Sections:
 - 1. Section 09 72 00 – Wall Coverings.
 - 2. Section 11 30 13 – Residential Appliances.
 - 3. Section 12 35 30 – Residential Casework.
 - 4. Division 22 – Plumbing.

1.2 REFERENCES

- A. Architectural Woodwork Institute: AWI - Quality Standards Illustrated.
- B. ASTM International:
 - 1. ASTM C 834: Standard Specification for Latex Sealants.
 - 2. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
 - 3. ASTM D 638: Standard Test Method for Tensile Properties of Plastics
 - 4. ASTM D 648: Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
 - 5. ASTM D 2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
 - 6. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 228: Standard Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer.
 - 8. ASTM G 21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- C. SCAQMD Rule 1168: Adhesive and Sealant Applications.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: fully dimensioned shop drawings showing countertop layouts, joinery, terminating conditions, substrate construction, cutouts and holes. Show plumbing installation provisions. Include elevations, section details, and large scale details.
- C. Samples: Submit four samples of each selected color by Architect.
- D. VOC Limits: Include manufacturer's literature for each adhesive, coating and sealant used in this Section identifying VOC limits and chemical components. All adhesives must conform to the South Coast Air Quality Management District Rule 1168 and all sealants must conform to Bay Area Air Quality Management District – Regulation 8, Rule 51, if applicable.

1.4 QUALITY ASSURANCE

- A. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties, if required.
- B. Warranty: Specimen copy of specified warranty.

1.5 QUALIFICATIONS

- A. Fabricator Qualifications: Minimum of three years documented experience in fabricating solid surfacing countertops similar in scope and complexity to this Project. Currently certified by the manufacturer as an acceptable fabricator.
- B. Installer Qualifications: Minimum of three years documented installation experience for projects similar in scope and complexity to this Project, and currently certified by the manufacturer as an acceptable installer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver sinks in original containers.

1.7 STORAGE AND PROTECTION

- A. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer. Store sheet materials flat on pallets or similar rack-type storage to preclude damage.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements and openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- B. Adhesive: Acclimatize adhesives to occupancy room temperatures with maximum temperature not to exceed 75 deg F.

1.9 WARRANTY

- A. Manufacturer's Limited Warranty: Provide manufacturer's standard 10 Year Commercial Limited Warranty against defects in solid surface sheet materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Specifications are based on LG Hausys Hi-Macs Solid Surface or approved equal.
 - 1. Substitutions: Section 01 60 00 - Product Requirements.
- B. Material: Cast, homogeneous, non-porous, decorative surface, comprised of acrylic components.
- C. Finish: Surface finish shall be manufacturer's standard finish selected by the Architect. Fabricator will supply a sample of the finish to be approved by the Architect prior to fabrication of the product.
- D. Countertops: ½" thick.

- E. Edge Detail: selected by Architect from standard offerings.
- F. Back & side splashes: 4" tall in locations indicated on the drawings.
- G. Physical Characteristics:
 - 1. Tensile Strength: 6000 psi; ASTM D 638.
 - 2. Tensile Modulus: 1.5×10^6 psi; ASTM D 638.
 - 3. Tensile Elongation: 0.5 percent minimum; ASTM D 638.
 - 4. Flexural Strength: 8,407 psi; ASTM D 7638
 - 5. Flexural Modulus: 1.34×10^6 psi; ASTM D 638.
 - 6. Thermal Expansion Coefficient: 1.7×10^{-6} in./in.°F; ASTM E 228.
 - 7. Hardness (Barcol Impressor): 65; ASTM D 2583.
 - 8. Stain Resistance: Passes; NEMA LD 3.4, ISFA SST 3.1.
 - 9. Wear and Cleanability: Passes; ANSI Z 124.3 & Z 124.6.
 - 10. Fungi & Bacterial Resistance: No Effect; ASTM G 21.
 - 11. Boiling Water Resistance: Passes; NEMA LD 3.5.
 - 12. Surface Burning Characteristics: Class A; ASTM E 84 & NFPA 101.

2.2 ACCESSORY MATERIALS

- A. Sealants: When required, sealants shall be 100% silicone and shall be matched to sheet color unless otherwise noted.
- B. Adhesives: Flexible adhesive shall be 100% silicone and shall be matched to finish surface. Rigid structural adhesive shall be manufactures recommended seam adhesive.

PART 3 EXECUTION

3.1 PREPARATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Examine substrates and conditions that could adversely affect the work of this Section.
- C. Substrates must be sound, flat, smooth, and free from dust or other surface contaminants.
- D. Commencement of work will constitute acceptance of substrates and conditions to receive the work.
- E. Fabricate and install work at temperature above 65 degrees.

3.2 INSTALLATION

- A. Install solid surfacing components plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Use woodworking and specialized fabrication tools acceptable to manufacturer.
- B. Form joint seams with specified seam adhesive. Seams to be inconspicuous in completed work. Seams in locations shown on approved shop drawings and acceptable to manufacturer. Promptly remove excess adhesive.
- C. Provide minimum 1/2 inch radius for countertop inside corners.
- D. Fill gaps between countertop and terminating substrates with specified silicone sealant.

- E. Rout sink cutouts to manufacturer's template. Adhere solid surface cast sink units to countertops with specified adhesive.
- F. Install backsplashes and endsplashes where indicated on Drawings. Adhere to countertops with specified construction adhesive.
- G. Vanities: Secure front panels to solid substrate with specified construction adhesive. Maintain 1/16 inch gap between fixed and removable panels.

3.3 REPAIRS

- A. If permissible to Architect, minor surface marring for solid surfacing components may be repaired according to manufacturer's published installation instructions.
- B. Remove and replace solid surfacing components that are damaged and cannot be satisfactorily repaired.

3.7 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. See section 01 50 01.

3.8 CLEANING AND PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean solid surfacing components according to manufacturer's published maintenance instructions. Completely remove excess adhesives and sealants from finished surfaces.
- C. Protect completed work from damage during remainder of construction period.

END OF SECTION

SECTION 26 05 90
ELECTRICAL REQUIREMENTS FOR AV

PART 1 GENERAL

1.1 SUMMARY

- A. The work of this Section is part of the Base Bid.
- B. Section Includes:
 - 1. Electrical work shown on AV-series drawings, related to Audio/Visual (AV) systems.
 - 2. Raceway systems, including cable tray, conduits, wireways, raceway fittings, boxes, cover plates, enclosures, terminal cabinets, and terminal boards.
 - 3. Installation of special back-boxes and plaster rings for control panels.
 - 4. Dedicated, 120 VAC, 20 Amp, branch circuits, and plugmold/receptacles for audio systems equipment.
 - 5. Special grounding conductors for electronics equipment cabinets, video projectors, televisions, and other AV equipment.
 - 6. Branch power circuitry and interfacing for low-voltage control for motorized projection screens.
 - 7. Coordination with the work of the AV systems Contractor(s).

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Products Installed but not Furnished Under this Section
 - 1. Equipment rack cabinets and special backboxes furnished under Division 27.
- B. Related Requirements
 - 1. Audio/video (AV) equipment and conductors (wire and cabling) are not included in Division 26, and are specified in Division 27.
 - a. Section 27 41 00 Basic Materials & Methods for AV
 - b. Section 27 41 10 AV Systems
 - 2. Firestopping – Divisions 07 and Section 07.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Allowances
- B. Unit Prices
- C. Alternates
 - 1. None.
- D. Measurement Procedures

1.4 REFERENCES

- A. Abbreviations and Acronyms
- B. Definitions
- C. Reference Standards
 - 1. EIA/TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Under this Section, coordinate with AV Subcontractor's work specified under Division 27.
 - 2. Wiring methods, locations for back-boxes and outlet/terminal boxes for AV equipment, locations for conduit/junction boxes, routing of conduits and power conductors for audio, video, computer video, control, and power to AV equipment.
- B. Preinstallation Meetings
- C. Sequencing
- D. Scheduling

1.6 SUBMITTALS

- A. Submit the following in accordance with the provisions of other Sections of Division 26.
 - 1. Submit product data for all products and materials specified under this Section separately from other submittals of Division 26, for review by both the Electrical Engineer and by AV Consultant.
 - 2. Coordinate conduit riser and schedule with Shop Drawings prepared by AV Contractor under Section 27 41 00.
- B. Samples
- C. Certificates
- D. Delegated Design Submittals
- E. Test and Evaluation Reports
- F. Manufacturers' Instructions
- G. Source Quality Control Submittals
- H. Site Quality Control Submittals
- I. Manufacturer Reports
- J. Sustainable Design Submittals
- K. Special Procedure Submittals
- L. Qualification Statements
- M. Copies of Permits

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts
- B. Operation and Maintenance Data
- C. Bonds
- D. Warranty Documentation
- E. Record Documentation
- F. Sustainable Design Closeout Documentation
- G. Software

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts
- B. Extra Stock Materials
- C. Tools

1.9 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals
- B. Qualifications
- C. Certifications
- D. Sustainability Standards Certifications
- E. Preconstruction Testing
- F. Site Samples
- G. Mock-ups

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements
- B. Storage and Handling Requirements
- C. Packaging Waste Management

1.11 SITE CONDITIONS

- A. Ambient Conditions
- B. Existing Conditions

PART 2 PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

- A. New Products
- B. Existing Products

2.2 GENERAL

- A. Except as otherwise specified within this Section, provide products and materials as specified in other Sections of Division 26.

2.3 CONDUITS

- A. Conduits shall be EMT throughout, sized appropriately to not exceed fill limitations under the NEC.
- B. Cable isolation and separations defined in NEC shall be followed at all times.

2.4 OUTLET GANG BOXES

- A. Except where otherwise shown, provide as specified below with minimum depths (including plaster ring) of:
 - 1. Control Panels: at least 3.5 inches.
 - 2. Input receptacles: at least 2.5 inches.
 - 3. Gang Boxes shown/specified as "deep": at least 3.5 inches.
- B. Flush-mounted:

1. One- and Two-gang boxes: 4" square box with single-gang and double-gang plaster rings, respectively.
 - a. Minimum depth: 2.25 inches.
 - b. Provide extension box or ring where additional depth is required or shown.
 2. Outlet boxes (three-gang and larger): ganged or masonry boxes, 3 inches deep (minimum).
 - C. Surface-mounted:
 1. Shall match and be the same manufacturer as those specified and submitted under other Sections of Division 26 for surface metal raceway.
 - D. Provide barriers plates as required to divide power and Class 1 wiring from Class 2 and Class 3 wiring.
 - E. "Spider" boxes:
 1. Spider Manufacturing Inc. WSCS-*-MMO series multimedia boxes with trim rings and insert panels.
 2. Size: as shown on drawings.
- 2.5 SPECIAL BACKBOXES
 - A. Touchscreen Back-boxes.
 - B. Furnished under Division 27, installed under this Section of Division 26.
- 2.6 SURFACE METAL RACEWAY
 - A. Provide products as specified in other Sections of Division 26.
- 2.7 FLOOR BOXES
 - A. Floor Boxes: provide as specified in <VERIFY> .
- 2.8 TERMINAL CABINETS
 - A. Terminal Cabinets
 1. Description: Terminal cabinets for termination of audio wiring under Division 27, and interfacing to rack cabinets.
 2. Specifications:
 - a. Cold-rolled steel, conforming with NEC.
 - b. Size: as shown on drawings, or as required to terminate conduits, whichever is larger.
 - c. Screw covers.
 - d. Chase nipples: 3 inch, minimum trade size.
 3. Manufacturer: Circle AW, or approved equal.
- 2.9 CABLE TRAY
 - A. Open ladder type, sized as shown on drawings.
 - B. Provide as specified in 27 41 10 .
- 2.10 BRANCH CIRCUITS
 - A. Plugmold
 1. Description: Plugmold (surface metal raceway with integral receptacles) for mounting within equipment cabinets provided under Division 27.
 2. Specifications:

- a. Provide plugmold with at least 6 receptacles, within each rack.
- b. Provide dedicated AC Circuits with flexible conduit connections at racks.
- c. Do not share grounding conductors with other non-AV systems.
- 3. Manufacturer: Wiremold 2000 or approved equal.

2.11 SPECIAL GROUNDING

- A. Conductors
 - 1. Description: Grounding conductors to bond equipment cabinets to ground. These grounding conductors are in addition to the grounding conductors of branch circuits.
 - 2. Specifications:
 - a. #6 AWG, minimum size.
 - b. Stranded insulated copper.
 - 3. Manufacturer: as specified in other Sections of Division 27 for other grounding conductors.

2.12 ACCESSORIES

- A. Plates
 - 1. Except where shown otherwise, provide blank stainless steel plates for outlet boxes.
- B. Pull Wires
 - 1. Plastic, with minimum tensile strength of 200-pounds.

2.13 SOURCE QUALITY CONTROL

PART 3 EXECUTION

3.1 INSTALLERS

- A. Installer List
- B. Substitution Limitations

3.2 EXAMINATION

- A. Verification of Conditions
- B. Preinstallation Testing
- C. Evaluation and Assessment

3.3 PREPARATION

- A. Protection of In-Place Conditions
- B. Surface Preparation
- C. Demolition

3.4 INSTALLATION

- A. General
 - 1. Except as otherwise specified within this Section, comply with other Sections of Division 26.

2. Provide and install accessories as required to form complete systems for raceway, grounding and power branch circuitry.
- B. Outlet Boxes and Special Backboxes
 1. Install back-boxes to be exactly centered in ceiling tile or building element, with sides of box (or lines between fastener holes for round enclosures) exactly parallel to ceiling grid or building lines.
 2. Caulk speaker enclosures to ceiling (lay-in tile or GWB) to form an airtight seal.
 3. Do not support speaker enclosures with lay-in tiles or GWB. Provide adequate support (using attachments to structural elements and/or metal mounting bars) for back-boxes so that no perceptible sag will occur once speaker and grille are mounted (assume a 10 pound weight for 8 inch speaker and grille, and a 6 pound weight for 4 inch speaker and grille).
- C. Raceway
 1. Install AV raceway to comply with NEC chapters 1-3, regardless of the class of wiring to be installed. Install raceway for AV wiring, except where otherwise shown or noted. Provide conduits for all AV wiring except where otherwise shown.
 2. Do not install conduits in wet locations or within concrete slabs-on-grade, except for runs to floor boxes that are in slabs-on-grade, or where explicitly noted to be installed in a wet location or slab-on-grade.
- D. Raceways and Conduits
 1. Do not combine conduit runs that are shown separately on the drawings.
 2. Install pull-wire in each run of conduit over 4 feet long. Leave at least 18 inches of slack in the pull wire at each end of the conduit run, and within each pull box.
 3. Provide an insulated bushing on each end of all conduits, including conduit stubs.
- E. Mounting Heights:
 1. Except where otherwise shown on the drawings, mount audio receptacles at the following heights:
 - a. Input receptacles: at same height as nearest duplex outlet for power.
 - b. Control panels: at same height as nearest light switch.
 - c. Screen controls: at same height as nearest light switch.
- F. Routing and Separation from Other Circuits:
 1. Do not alter the topology (routing pattern) of conduits from that shown on the drawings without the prior, written consent of the AV Consultant. Show final routing on the Record Documents.
 2. Install separate conduits for microphone, line-level audio, speaker, control wiring, and power circuits/grounding wires.
 3. Install AV system raceway to maintain the minimum spacing indicated on drawings.
 4. Where conduits stub out to cable tray, install so that the bushing on the end of the conduit is easily accessible, and within 12 inches of the edge of the cable tray horizontally, and within 24 inches of the cable tray vertically, but does not extend over the cable tray. Do not provide a down-turning bend at the cable tray. Bond the conduit to the cable tray at

the point of stub out above the tray, using a grounding wire or other approved means.

- G. Maximum distance between Pullboxes
 - 1. Install accessible pull boxes as required so that no conduit pull is longer than 100 feet, and that no conduit run contains more than a cumulative total of 180 degrees of bends (count each offset as 45 degrees of bending).
 - 2. Clearly document the exact locations of pull boxes, and provide documentation to the AV Contractor. Show exact locations on the Record Drawings.
- H. Bend Radius
 - 1. Install conduits so that the inside radius of each bend is made in accordance with NEC.
- I. Branch Circuits
 - 1. Provide quantities and sizes of branch circuits for electronics equipment cabinets as shown on drawings.
- J. Grounding
 - 1. Run special grounding conductors to same panelboard that feeds branch circuitry for equipment cabinet. At panelboard end, connect to ground bus of panelboard. At equipment cabinet, securely bond to cabinet using bolted connection.
- K. Identification
 - 1. Label each conduit and other raceway at each end with the purpose (e.g. "AV" and destination (e.g. "to Meet Room 147")).
 - 2. Label each outlet box, back-box, and pull box with purpose and device number (e.g. "AV Control Panel #1").
 - 3. Provide labeling which is clear and permanent, such as black permanent-ink marker.
- L. Special Techniques
- M. Interface with Other Work
- N. Systems Integration
- O. Tolerances

3.5 RE-INSTALLATION

3.6 SITE QUALITY CONTROL

- A. Site Tests and Inspections
- B. Non-Conforming Work
- C. Manufacturer Services

3.7 SYSTEM STARTUP

3.8 ADJUSTING

3.9 CLEANING

- A. General

1. Remove dust, dirt and debris from the interior of enclosures, outlet boxes, pull and junction boxes, and equipment racks and cabinets.

B. Waste Management

3.10 CLOSEOUT ACTIVITIES

3.11 DEMONSTRATION

3.12 TRAINING

3.13 PROTECTION

3.14 MAINTENANCE

END OF SECTION

SECTION 27 41 00
BASIC MEANS AND METHODS FOR AV

PART 1 GENERAL

1.1 SUMMARY

- A. AV Consultant for this project is:
 - The Greenbusch Group, Inc.
 - 1448 Elliott Ave W
 - Seattle, Washington, 98119
 - (206) 378-0569
 - NateG@greenbusch.com
- B. This section contains the general requirements for basic materials and installation methods that apply to related sections of Division 27, and is part of the Base Bid.
- C. The work of this Section and related sections is shown on the "AV-xx"-series of drawings.
- D. Section Includes
 - 1. Provide for the completion of design details, furnishing, installing, testing and configuring to provide a fully operational system. Provide all labor, equipment, materials, devices and necessary appurtenances to provide complete and fully operational systems.
 - 2. Connection to and integration with other equipment provided by the Owner.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Products Installed but not Furnished Under this Section
 - 1. Loudspeaker backboxes to be installed under Division 26.
 - 2. Equipment Cabinets to be installed under Division 26.
- B. Related Requirements
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 2. Section 26 05 90: Electrical Requirements for AV systems.
 - 3. Section 27 41 10 AV Systems

1.3 PRICE AND PAYMENT PROCEDURES

- A. Alternates
 - 1. Additive Alternate #1
 - a. Install infrastructure for future surround sound loudspeakers.

1.4 REFERENCES

- A. Reference Standards
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Manufacturer's Association (NEMA)
 - 3. National Fire Protection Association (NFPA)
 - 4. Underwriter's Laboratories (UL)
 - 5. EIA/TIA

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Prior to roughing-in, verify the exact location of all devices with Architect.
2. The Contractor shall continually interface and coordinate the work with the work of the other Contractors and trades, including that being done under separate Contracts, and shall examine all drawings and specifications of other trades including the mechanical, architectural, and structural for construction details and coordination.
 - a. Obtain submittals, shop drawings, and other information for all equipment to be furnished by Owner or under other divisions of the specifications.
 - b. Schedule work to prevent conflicts with other activities in the building. Execute without claim for extra payment moderate moves or changes as are necessary to accommodate other trades and equipment, or preserve symmetry and pleasing appearance.
 - c. No increase in the Contract Amount will be allowed or due to the AV Contractor for work of relocation of equipment, conduits, cabling, or any other materials resulting from insufficient coordination.

1.6 SUBMITTALS

A. General

1. Submit as specified under Division 01, except as otherwise specified in this Section.
2. Submittals and shop drawings which are incomplete or which contain insufficient information will be returned without review, for corrections and re-submittal.
3. By submitting, the contractor agrees that submittals are not change orders, and that:
 - a. The purpose of submittals by the Contractor is to demonstrate that the Contractor understands the design concept, that it demonstrates its understanding by indicating which equipment and material it intends to furnish and install, and by detailing the fabrication and installation methods it intends to use.
 - b. The Consultant's reviews are for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy for confirming and correlating all quantities and dimensions, for selecting fabrication processes and for techniques of assembly.

B. Submittal Schedule

1. Submit within the following number of calendar days after Notice to Proceed. Proceeding with product purchases or installation prior to approval of these submittals shall be Contractor-at-risk work subject to no compensation by the Owner.
 - a. Qualifications Statement: 10 business days
 - b. Requests for Substitution: 10 business days
 - c. Product Data: 30 business days

- d. Shop Drawings: 60 business days
 - 1) Include Conduit Riser and Schedule in accordance with Section 26 05 90.
 - e. Labeling methods and nomenclature
 - 2. Submit prior to Final Completion:
 - a. Completion Report
 - b. Record Documents
 - c. Operations Manuals
 - d. Maintenance Manuals
- C. Product Data
 - 1. Equipment list, on contractor's letterhead listing equipment and materials including but not limited to:
 - a. Items listed in the specifications
 - b. Wire and cable
 - c. Interfaces
 - d. Connectors and termination devices
 - e. Housings, mounting frames and hardware
 - 2. For each item of equipment, include:
 - a. A reference number.
 - b. Manufacturer and model number.
 - c. Description.
 - d. Approximate quantity being furnished.
 - e. Special conditions or exceptions (if any).
 - f. Attach a copy of the manufacturer's catalog or specification sheet for each item. Mark each sheet with the same item reference number(s) used on the equipment list. If more than one item or version is shown on a sheet, clearly mark the sheet to indicate which item(s) or version(s) are being furnished.
 - g. If required elsewhere, also attach laboratory test data on specific items of equipment.
 - 3. For each item, clearly mark or indicate listing by UL or other approved testing agency.
 - a. For audio power amplifiers, indicate the listed NEC Class of output wiring.
- D. Shop Drawings:
 - 1. General
 - a. Showing floor/ceiling plans with complete device layout and diagrams showing point-to-point wiring and connection diagrams between all components of the system.
 - 2. Shop Drawings are required for:
 - a. Floor plans, showing the layout of devices and cabling and wiring between devices. For each run, show the number of cables, type of cables, size of raceway, and fill calculations.
 - b. Single line diagrams showing model numbers of each component. Include wire/cable numbers for each connection.
 - 1) Show all items, ports, and signal paths; "typical" drawings are not acceptable.
 - a. Wiring diagrams showing point to point connections between components. Include color-coding for each connection point.

- 2) "Typical" drawings are acceptable, if referenced at each point from the Single Line diagrams.
 - c. Rack panel layout for each equipment cabinet.
 - d. Scaled and dimensioned drawings of all custom assemblies and fabricated items, including but not limited to the following. Include details of all components, materials, finishes, and colors.
 - 1) Loudspeaker clusters, including mounting details and attachments to structural members
 - 2) Control Panel Mounting
 - 3) Projector and Display Mounting Frames and Hardware
 - 4) Screen Mounting
 - 5) Input/Output Panels, including mounting of panels in casework.
 - 3. With the Shop Drawings, submit:
 - a. Preliminary cable numbering lists.
 - b. Detailed description of the proposed cable numbering system, complying with specified requirements.
- E. Qualification Statements
 - 1. Letters from the General Contractor and AV Subcontractor, on their respective letterheads, identifying the AV Installation Manager and verifying that individual satisfies experience requirements in this Section.
 - a. If at any point this AV Installation Manager is replaced on the Project, an updated statement shall be provided within 10 business days.
- F. Copies of Permits
 - 1. Photocopy of specialty electrical contractor's license for the AV Subcontractor.
 - 2. Photocopy of each permit issued for the AV work.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts
- B. Operation and Maintenance Data
- C. Bonds
- D. Warranty Documentation
- E. Record Documentation
 - 1. General
 - a. Submit under provisions Division 01, except as otherwise specified in this Section.
 - b. Include work installed under addenda and change orders in the Record Documents.
 - 2. Record (As-Built) Drawings
 - a. Continually record the actual "as-built" installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone. At the completion of the work, Contractor shall furnish the Designer a set of reproducible record drawings (Xerox type) and the set of mark-ups. Final payment to the Contractor will not be authorized until these prints have been submitted to and accepted by the Designer and Owner.

- b. Record drawings shall include, at a minimum, updates of all sheets of the Submittal Drawings.
 3. Operations Manuals and Maintenance Manuals
 - a. Operations Manuals shall be separate from Maintenance Manuals.
 - b. The O&M Manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project.
 - c. The information included must be the exact equipment installed, not the complete "line" of the manufacturer. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
 - d. The information contained in the manuals shall be grouped in an orderly arrangement by specification index.
 - 1) Arrange the manuals by room/system, with a Common section containing materials that apply to more than one room/system.
 - 2) The cover page shall be labeled with the name of the job, Architect, Designer, Contractor and year of completion.
 - 3) Include the following information:
 - a) Project Title.
 - b) Project Architect.
 - c) AV Consultant.
 - d) AV Subcontractor.
 - e) Completion Date.
 4. Operations Manuals
 - a. As a separate manual for each system, include:
 - 1) Complete and comprehensive operating instructions prepared especially for this project. Include turn-on and turn-off procedures, typical operating methods and control settings for each method, and simplified block diagram with explanatory narrative. Standard documents published by the manufacturers shall not be acceptable to meet this requirement.
 - 2) Short-form operating instruction sheets prepared especially for this project, having simple and abbreviated instructions suitable for "non-technical" users with limited knowledge of the systems. Standard documents published by the manufacturers shall not be acceptable to meet this requirement.
 - 3) Manufacturers' standard operating instructions and owner's manuals for all items of equipment. Omit installation, servicing, and other technical information.
 - 4) Updated equipment list, including loose items.
 - 5) Include only operating and instructional material in Operations Manuals; do not include technical material or other servicing items.
 5. Maintenance Manuals
 - a. Combined manual for all AV systems.

- b. Updated equipment list including serial number of each item. List loose items on a separate sheet. Include addresses and telephone numbers for each manufacturer.
 - c. Cable numbering list as a computerized spreadsheet, in a format compatible with Microsoft Excel.
 - d. Evidence of final electrical inspection.
 - e. A copy of the delivery receipt for, and a list of, loose items.
 - f. Warranty Information, including but not limited to:
 - 1) An overall Statement of Warranty from the AV Subcontractor for the complete systems. Include names, address(es), and business telephone number(s) of installing contractor.
 - 2) Instructions for obtaining warranty service from the AV Contractor, and from each Manufacturer.
 - g. Manufacturers' publications for each item of equipment:
 - 1) A copy of the Manufacturers' warranties, with names, address(es), and business telephone number(s) of installing contractor.
 - 2) Recommended operation instructions.
 - 3) Equipment brochures and cut sheets as appropriate. Do not include general catalogs.
 - 4) Service manuals as published by the manufacturers, and other manufacturers' servicing data.
 - 6. Recorded Test Data
 - a. Final equalization settings
 - b. Internal and fixed control settings
 - c. Signal delay and processor settings
 - d. Software configurations, programming code, source code, and IR codes
 - e. Include the names of the individuals performing and witnessing the tests, and the manufacturer and model of each item of test equipment which was used. Include block diagrams of the test setup for tests that involve more than one item of test equipment.
 - F. Sustainable Design Closeout Documentation
 - G. Software
 - 1. Control panel layouts
 - 2. DSP configurations and programming
- 1.8 QUALITY ASSURANCE
- A. General
 - 1. Systems and equipment specified under this Section and related Sections shall be provided and installed by a single subcontractor specializing in AV systems, communications, and electronics systems.
 - B. Qualifications
 - 1. Installers
 - a. Provide adequate staff throughout the project, included a designated field foreman at the project site, and in responsible charge during site visits, observations, and testing by Consultant. Do not change the person assigned as foreman, unless required

- by illness or termination of employment, or other compelling circumstances. Promptly notify the Consultant and Owner of personnel changes.
- b. In the business of installing and maintaining the types of AV systems and equipment specified for this project, under the Contractor's present corporation or business license, for a period of at least 5 years.
- 1) Experience as a regular electrical contractor or surveillance television systems contractor shall not apply to this requirement.
- c. This experience shall include at least three of each of the following types of projects:
- 1) Sound systems that have included DSP-based equalization and processing.
- 2) Video systems which have included high-resolution computer graphics.
- 3) Integrated control systems which included programming of touchscreen or computer-based control panels.
- 4) Networked AV systems utilizing Cobranet, Dante, AVB, or AES67 protocols.
- d. Upon request, submit a list of installations performed for verification by the Consultant. Include:
- 1) Project name, description, and location.
- 2) Date completed.
- 3) Dollar amount of contract for AV (excluding raceway, electrical, and other general construction).
- 4) Contact names, with an email address and telephone number for each name.
- 5) Indicate which projects may allow visits by the Owner.
- 6) Where not prohibited by Non-Disclosure Agreements, submit:
- a) Photographs of the completed work.
- b) Excerpts of Record Documents ("as-built" drawings, Operations and Maintenance Manuals, etc.).
- 7) A manufacturer-authorized dealer or distributor and installer for at least 3 years for each major brand of equipment to be supplied as part of this project.
- a) Owner may grant specific exceptions for limited items of equipment, provided that a request is submitted with the bid and is approved by the Owner prior to equipment procurement or installation.
- b) This provision does not apply to items of equipment being furnished by Owner or other vendors.
- e. Testing Agencies
- f. Licensing
- 1) AV Subcontractor shall be licensed as a required by local regulations and Authorities Having Jurisdiction, including as a specialty low-voltage electrical contractor in the project jurisdiction where such licensing is available.

- 2) Installing contractor shall have held a valid and applicable contractor's license, such as a specialty electronics contractor's license, for at least 5 years.
- 3) Having held a general business or retailer's license shall not be construed as meeting this requirement.

C. Certifications

1. Designated AV Installation Manager that holds active an active Certified Technology Specialist - Installation (CTS-I) credential administered by AVIXA.

1.9 PROJECT CONDITIONS

A. Contract Documents

1. The drawings do not show all requirements of the specifications. The drawings and specifications are complementary and what is called for (or shown) in either is required to be provided as if called for in both. If in conflict, the specifications shall take precedence.
2. Equipment racks, connection panels, and all other associated devices are shown diagrammatically only and indicate the general character and approximate location. Furnish, install and place in satisfactory condition, all AV equipment, cabling and all other materials required for the systems shown or noted in the contract documents, so that it is a complete system which is fully operational and fully tested.

B. Codes and Standards

1. Perform all work and provide materials and equipment in accordance with the codes, laws, and regulations as adopted and/or enforced by the local Authorities having Jurisdiction for the project site.
2. Provide UL listed products where required and for which listing service is available.
3. Conform to the following Codes, as adopted and amended by the Local Jurisdiction:
 - a. NFPA 70 (National Electrical Code, NEC)
 - b. UBC (Uniform Building Code)
 - c. Local regulations, as applicable
4. The referenced codes and standards establish a minimum level of requirements.
 - a. Where provisions of the codes/standards or the Contract documents conflict with local laws, regulations, or codes, the local provisions shall govern.
 - b. Where provisions of the codes/standards conflict with each other, codes shall take precedence over standards, and the more stringent provisions shall govern.
 - c. If any conflict occurs between referenced codes and this Contact documents, the codes shall govern.
 - d. The regulatory requirements establish minimum standards for the work, but do not relieve the contractor from work shown or specified that exceeds such standards.

C. Permits, Inspections

1. Obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein.

2. Arrange for, and pay fees and charges for, inspection of work by the Authority Having Jurisdiction.
- D. Software Ownership
 1. Commercial software that is provided by Manufacturers as accessories to products shall be provided to Owner, with Owner to be registered as the owner of the software's licensing agreement.
 2. For software (including configuration of commercial software and firmware) that is developed by Contractor and provided as part of the project, the Contractor shall provide a non-exclusive license to the Owner, fully paid in perpetuity, allowing full use and creation of derivative works, on the Owner's premises. Transfer of ownership of the Copyrights is not required.

1.10 WARRANTY

- A. Refer to General Conditions of the Contract. Comply with Division 01.
- B. During the warranty periods, the Contractor shall repair or replace, at its own expense, defective work, equipment and materials.
 1. The initial warranty period shall run for one year from the date of final acceptance or first beneficial use, whichever is later, or as specified in Division 01, whichever is later.
 2. Warranty work shall be performed at the project site and is intended to occur in normal working hours.
 - a. On-site service at other than normal working hours shall be available at additional cost to the Owner, at current labor rates.
- C. During warranty periods, Contractor shall provide routine maintenance, at least annually or at the manufacturers' recommended service intervals whichever is less, including but not limited to:
 1. Testing to verify functions and performance of systems to be within these specifications and manufacturers specifications.
 2. Adjustments as required to restore or optimize performance.
 3. Cleaning of lenses, filters, and optical elements of projectors.
 4. Replacement of filters and lamps.
 - a. Filters and lamps will be furnished by Owner from Spare Parts stock.
- D. Response time
 1. Warranty diagnosis and repair shall commence not more than 24 hours after notification of Contractor.
 2. If warranty repairs or replacements take more than 4 working days, provide temporary equipment to maintain usability of complete systems at no additional cost to the Owner.
- E. The warranty shall cover the accuracy of technical documentation, and signal quality as specified and documented during the testing process of this project.
- F. In addition to the warranty provided by the AV Contractor, the benefits of Manufacturers' warranties shall be endorsed to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- B. Install complete and operating systems. Provide and install accessories as required (whether shown and/or specified or not) to form complete and operating systems. The overall governing requirement is to provide complete and operational systems.
- C. Equipment shall be new, unused, and undamaged, except as otherwise shown, or otherwise agreed in writing.
- D. Where these specifications include model or series numbers, provided equipment (including substitutions) shall meet or exceed the manufacturer's published specifications for the specified model or series the same as if the manufacturer's published specifications were enumerated within these project specifications. This requirement is in addition to the other requirements given in the project specifications. This requirement is not intended to apply to characteristics (such as color or appearance) which do not affect the performance, function, reliability, or durability.
- E. Manufacturer:
 - 1. Where several manufacturers are listed, contractor may choose which manufacturer to provide.
 - 2. Do not provide an assortment. For each category, provide products of the same manufacturer; for each item, provide the same model for all instances.
- B. Substitutions:
 - 1. Submit in accordance with Division 01, except as otherwise specified in Division 27.
 - 2. Requests for substitutions for products of Division 27 shall be submitted for pre-bid approval. All requests must be received by the Owner in writing no later than 10 days prior to bid date.
 - a. Itemize any variation from the specifications. For each item, refer to the pertaining Section and Paragraph, and indicate the reason for, and/or the advantage of, the substitution.
 - 3. Requests for substitution that do not comply with these requirements will not be considered. Substitutions after this deadline will be considered only if specified or previously submitted product is:
 - a. not available in time to meet required installation dates, or
 - b. substantial cost savings to the Owner and/or increases in system performance are proposed.
 - 4. Requests for Substitution that are approved will be published in an Addendum.
 - 5. Under this Section, provide revisions and alterations to work of other Divisions which may be necessary as a result of such substitutions.
- C. Equality
 - 1. Where product specifications indicate "or approved equal", other products of equal quality and function may be furnished, subject to prior approval by the Owner, Architect, and AV Consultant.
 - 2. Where product description does not indicate "or approved equal", substitutions shall be approved prior to bidding.
 - 3. Proof of equality rests with the submitter. The AV Consultant shall be the final judge of equality.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Preinstallation Testing
 - 1. Prior to installation, verify performance of each and every item of equipment (including those furnished by Owner or others).
 - 2. For items or components that do not meet factory specifications, and which are furnished by Installer, repair or replace items or components prior to installation.
 - 3. For items furnished by Owner or others, inform AV Consultant of deficiencies.

3.2 INSTALLATION

- A. General
 - 1. Completed work shall represent a neat and orderly appearance.
 - 2. All work and materials shall be subject to observation at any and all times by representatives of the Architect and AV Consultant.
- B. Interface with Other Work
 - 1. Cutting, Patching, and Painting
 - a. Comply with Division 01.
 - b. Obtain written permission from Owner and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.
 - c. All construction materials damaged or cut into during the installation of this work shall be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.
 - d. Painting will be provided under Division 01, except for refinishing of items furnished by the AV Contractor that are scratched or marred in shipment or installation.
 - 1) Under this Section, coordinate painting of speaker boxes and grilles with General Contractor.
- C. Penetration of Fire-Rated Elements
 - 1. Provide so that rating is retained.
 - 2. Fill sleeves with fire-stopping material in compliance with NEC.
 - a. Where sleeves open into areas occupied or in use for non-construction activity, maintain fire-stopping at all times throughout construction.
 - b. Acceptable products: T&B Flame Safe Compound, 3M Fire Barrier Caulk, Nelsen Electric Fireseal.
- D. Raceway and Conductors
 - 1. Raceway
 - a. Install wire and cable only within raceway systems. Do not install wire or cable in wall cavities or ceiling plenums/attic spaces without the use of raceway (conduit or cable tray), without the explicit written permission of Owner, or as otherwise noted on the drawings.

- b. Maintain conduit fills equal to or less than those of Table 1 of Chapter 9 of the NEC, regardless of the class of wiring.
- 2. Conductors and cables
 - a. Use only cable lubricants that are compatible with the jacket materials.
 - 1) Upon completion of pull, clean exposed cables and surfaces to be completely free of lubricant and residue.
 - b. To the greatest possible extent, cables shall be installed in continuous runs without splices.
 - 1) Where splicing is unavoidable, submit documentation showing locations and details for proposed splices for approval prior to pulling.
 - 2) Splice only in accessible junction boxes, using insulated crimp-on connectors, soldering covered with heat shrink, or other methods approved by the Engineer.
 - a) Do not splice in conduits or cable tray.
 - b) Splicing with wire nuts is prohibited.
 - c) Do not splice microphone wiring without specific written permission from the Consultant.
 - 3) Install the following types of circuits in separate raceway. Where not installed in raceway, install in separate bundles with maximum separation between types of circuits.
 - a) Microphone circuits.
 - b) Analog line-level audio circuits, digital audio/video circuits, analog video circuits, broadband circuits (CATV), and control circuits.
 - c) Class 2 Loudspeaker circuits.
 - d) Class 1 Loudspeaker circuits.
 - e) Telephone/data circuits.
 - f) Power and lighting circuits.
 - c. Minimum Separations:
 - 1) From power and switched lighting circuits: at least 24 inches.
 - 2) From dimmed lighting circuits: at least 48 inches.
 - 3) Where runs are adjacent for less than 50 feet, the required spacing may be halved (12 inches, or 24 inches from dimmed lighting circuits).
 - 4) Where runs are adjacent for less than 6 feet, or where circuits cross at right angles, separations of 2 inches may be used.
 - d. Where AV circuits cross or intersect with power or lighting circuits, cross at 90 degrees (plus or minus 2 degrees) to the greatest extent possible.
 - e. Maintain the minimum bend radius of cables as recommended by Manufacturers.
 - f. Protect installed conductors from painting, overspray, and taping/patching compounds.
 - g. Raceway
 - 1) Install wire and cable only within raceway systems. Do not install wire or cable in wall cavities or ceiling plenums/attic spaces without the use of raceway (conduit or cable tray),

without the explicit written permission of Owner, or as otherwise noted on the drawings.

- a) At the option of the AV Subcontractor (Division 27 Subcontractor), wiring for loudspeakers may be installed with or without conduit/raceway. Where installed without raceway, provide plenum-rated wiring where required.
 - 2) Maintain conduit fills equal to or less than those given by Table 1 of Chapter 9 of the NEC, regardless of the class of wiring.
3. Cable Installation
- a. Install cables and wiring neatly, forming straight lines and smooth corners, without deformation, kinks, scrapes, or cuts of the jacket or insulation. Secure with tie-wraps.
 - 1) Do not cinch cable ties too tightly; leave loose enough so each cable can be easily moved through the bundle.
 - b. Where installed without raceway, support cables with D-rings or J-hooks at minimum intervals of 48 inches.
 - 1) Do not put cable ties or J hooks at equal distances; place at random spacing.
 - c. Do not use cable ties in the cable tray or overhead junction boxes, except where otherwise shown or otherwise directed in writing by Owner.
 - d. On backboards, use support cables with D-rings on the outside edges of backboards.
 - e. Where bundles enter racks, arrange neatly without crossovers. Secure cable bundles within racks and equipment consoles with cable ties.
 - 1) Bundle separately, or install in separate plastic ducts, the microphone, line-level audio, speaker, control, video, and power wiring.
 - f. Where bundles are subject to flexing, enclose bundle with nylon webbing or spiral wrap; do not use tie-wraps.
 - g. Provide flexible service loops for cable assemblies for:
 - 1) Equipment in casework or racks which have less than 3 feet of clearance for rear access.
 - 2) Equipment with sliding mounting hardware.
 - 3) Provide sufficient loop length so that equipment can be fully pulled out for service without cutting wire ties or putting undue stress on cable assemblies.
 - h. Where cables are installed vertically, provide support at regular intervals. Maximum distance between supports shall not exceed 80 percent of the manufacturers' recommended maximum vertical drop, or 50% of the recommended maximum pulling tension, whichever is less.
 - 1) At a minimum, support cables at each floor with clamping strain relief.
- E. Mounting and Installation
1. Boxes, equipment, etc. shall be plumb and square, except as otherwise shown.

2. Equipment (except portable equipment) shall be firmly held in place. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three. Equipment shall be braced for seismic conditions according to applicable codes and regulations.
3. Video Displays
 - a. General
 - 1) Provide mounts rated at a minimum of 150% of the weight of the installed display device.
 - 2) Where it is possible to stand or sit under the display, provide safety cable attached directly to display and to building structure
 - a) Do not attach safety cable to case of display; attach to structural element of display so that display can be safely supported entirely by safety cable.
 - b) Do not attach safety cable to mounting apparatus.
 - b. Video Projectors
 - 1) In the horizontal plane, install with center of lens located within 1 inch of the centerline of screen.
 - 2) In the vertical plane, install with center of lens located within 4 inches of the optimal position recommended by the manufacturer.
 - 3) Install so routine maintenance (such as lens cleaning, replacement of lamp and filter, reset of counter, etc) can be done without removing projector from mount, or dismantling from ceiling.
4. Loudspeakers
 - a. Loosely fill speaker niches or metal speaker enclosures with unfaced, 0.75 lb/cu.ft, glass fiber batting.
 - b. Verify polarity of each speaker voice coil prior to installation and connect to maintain uniform polarity.
 - c. Where line matching transformers are used, tap as shown or to provide an amplifier load between 60% and 90% of rated capacity with all speaker-line attenuators (if any) set for minimum attenuation.
 - d. Loudspeaker clusters (hung assemblies)
 - 1) Install using to permit individual adjustments of tilt and yaw angles of at least plus or minus 5 degrees for each horn and full-range speaker assembly.
 - 2) Hang low frequency speaker enclosures, and full-range speaker assemblies, on neoprene-in-shear vibration isolators selected for the weight of each component.
 - 3) Develop mounting details and structural attachments in accordance with the recommendations of the Structural Engineer, and submit drawings to the Architect for approval prior to installing roughing-in work.
 - a) Provide safety cables attached directly to each speaker box and to structure; do not attach safety cables to mounting apparatus.
 - e. Flush-mounting speaker assemblies:

- 1) Install so speaker grille is centered in tile or building element, with sides of grille or line between mounting fasteners parallel to building lines.
 - a) Do not support speaker enclosures with lay-in tiles or GWB. Provide adequate support (using attachments to structural elements and/or metal mounting bars) for back-boxes so that no perceptible sag will occur once speaker and grille are mounted.
- 2) Caulk enclosures to ceiling surface to form an airtight seal. Do not caulk baffle or grille to ceiling.
- f. Self-enclosed "box" speakers
 - 1) Aim each loudspeaker directly at the primary listening position. Assume an ear height of 4 feet for seated listeners, and 6 feet for standing listeners.
 - 2) Wall-bracket or Ceiling-bracket mounting:
 - a) Except where otherwise shown, install using manufactured mounting apparatus such as OmniMount.
 - b) Provide mount rated at a minimum of 150% of the weight of the installed speaker.
 - c) Where it is possible to stand or sit under the loudspeaker, provide safety cable attached directly to speaker box and to structure; do not attach safety cable to mounting apparatus.
- F. Rack-Mounted Equipment
 1. Install racks to permit full swing-out of front and rear door, and swinging cabinet sections. Coordinate with work of other Divisions to insure full swing-outs.
 2. Mounting:
 - a. Install vent panels at top and bottom of rack, and between power amplifiers, except where otherwise shown or otherwise recommended by Manufacturer.
 - b. Install blank panels to fill any unused rack spaces.
 - c. Mount devices having operating controls or displays, such as video monitors, vectorscopes, mixers, control panels, and patch panels at convenient working height.
 - d. Within racks, install cables and wiring neatly, forming straight lines and smooth corners. Bundle separately, or install in separate plastic ducts, the microphone, line-level audio, speaker, control, video, and power wiring.
 3. Power Connections
 - a. Coordinate installation of power outlets and plug strips, receptacles, power branch circuits, and special grounding conductors under Division 26. Under this Section, verify proper connections of grounding conductors, grounded conductors ("neutrals"), and identified conductors ("hot wires") for power branch circuits.
- G. Terminations

1. Prior to connection, verify freedom from shorts or grounds of all conductors (including shields and drain wires) of all cables.
2. Terminate cables in terminal cabinets or other approved means on the walls of equipment rooms, to provide a demarcation/test point, with extension cable run to the rack/equipment. Do not run cables from devices directly to equipment racks.
3. Terminate unused RF tap, splitter, video outputs, and distribution amp ports with a 75 Ohm terminators.
4. If a signal path requires that the signal pass through more than one device, each device must have looping input capability, or a distribution amplifier must be used to feed the signal to the devices. Do not use a video "T" in place of a video distribution amp to route signals to more than one device.
5. All audio circuits shall be balanced (high, low, shield) except where otherwise indicated. Where devices with unbalanced ports are used, provide balance boxes located at the device to convert all connected ports to balanced.
6. Connections:
 - a. Make connections to plugs, receptacles, connectors, or solder terminals using rosin-core solder. Make connections to screw connections using insulated spade lugs.
 - 1) Ensure that no uninsulated wire is exposed beyond its pin, and no stray strands ("whiskers") are present.
 - 2) Utilize only multi-core flux resin with 60/40 tin-lead non-corrosive construction, designed for electronic equipment use.
 - 3) Soldering shall utilize good engineering practices, and completed solder connections shall appear shiny and smooth, without excessive solder and with no visible imperfections or cold-solder joints, and with wire strands visible.
 - b. Serve shielded cables with clear heat-shrink tubing to insulate shield and drain wire. For unterminated drain wires, serve drain wire in normal fashion, then fold back onto jacket and cover with clear heat shrink, to insulate the exposed end and to allow future termination of drain.
 - 1) Do not overheat insulation when heating tubing; do not bend conductors until insulation has cooled. Repair or replace cables with partially melted or deformed insulation.
 - c. Cable jacket shall be fully engaged by the strain relief of the connector.
 - d. For all crimp-type connectors and pins, utilize only crimp tools rated for the crimp pin type, size and wire gage being assembled. Consult the manufacturer's specifications and recommendations for crimping.
 - 1) Utilize only gold-plated crimp pins.
7. Pinouts
 - a. Wire all three and five pin audio connectors and quarter-inch phone jacks (mono and stereo) in accordance with IEC-268.
 - 1) For three pin connectors, Pin 1 is ground, Pin 2 is positive, and Pin 3 is negative.

- 2) For five pin connectors, Pin 1 is ground, Pin 2 is left positive, Pin 3 is left negative, Pin 4 is right positive, and Pin 5 is right negative.
 - 3) For quarter-inch stereo phone jacks, Tip is positive, Ring is negative, and Sleeve is ground.
 - 4) For quarter-inch mono phone jacks, Tip is positive and Sleeve is ground.
 - 5) Where manufactured items deviate from the above, wire as required and document the deviation on the Record Documents.
8. Signal Shielding and Grounding
- a. Verify integrity of grounding systems and isolated-ground receptacles prior to connection of equipment.
 - b. Install heavy copper buss bars inside cabinets, running vertically from top to bottom, along right side of cabinets (viewed from rear). Provide buss bars having tapped holes with terminating screws 6 inches on center (maximum spacing). Bond bars to cabinets, and connect special grounding conductors (provided under Division 26) to ground bars.
 - c. For each equipment room, install a single-point grounding system for termination of shields. Where multiple systems are installed in a single grouping of racks, they shall be considered one system for grounding purposes.
 - d. Do not use 3-prong to 2-prong adapters ("ground lifters") on power cords. Do not remove or defeat grounding terminal of 3 conductor power cords, and maintain safety grounding and bonding as required by the NEC.
 - e. Connect shield and grounding conductors as follows:
 - 1) For devices with grounding power cords having separate circuit and chassis grounds, connect circuit ground to rack's ground buss.
 - 2) For devices with grounding power cords having common circuit and chassis ground, omit grounding wire (grounding will occur through power cord).
 - 3) For devices with non-grounding power cords (two-wire), connect circuit ground to rack's ground buss.
 - 4) Connect shields of microphone wiring to receptacle and mixer input receptacles.
 - 5) Insulate shields from connector shell, plates, boxes, and raceway.
 - 6) Connect shields of line level circuits at output ends only; insulate at input ends.
 - 7) Maintain shield and drain wire continuity through junction boxes and intermediate termination points. Insulate shields from raceway or other conductive building elements. Maintain shields to within 3 inches of connected devices, and maintain twisting of pairs of wires to within 1/2 inch of connector or device termination.
 - f. Make any modifications to grounding and shielding which are necessary to eliminate extraneous noise and RFI, prevent oscillations, parasitics, and other signal instabilities, and to meet

overall systems noise specifications. Record any deviations from the above guidelines, and the reasons that each deviation was deemed necessary.

- g. The overall governing requirements are that the wiring systems shall not induce or pick up perceptible noise, and that the predominant components of the noise floor of all signal paths shall be normal "thermal" noise of the upstream devices.

H. Labeling

1. Conductors and Raceway

- a. Number- or color-code each cable. Number- or color-code individual conductors of cables to identify circuits and connections.
 - 1) Record number- and color-codes on the "as-built" drawings.
- b. Wire Run List: for each system, include the following on the wire run list, for each cable:
 - 1) Cable number.
 - 2) Signal type.
 - 3) Cable type.
 - 4) "To" destination
 - 5) "From" destination
 - 6) Room and equipment location for both ends of the cable
 - 7) Approximate length of cable run
- c. Label cables on each end, with number and identification legend clearly identifying the connection point for the cable end. Labels shall be self-laminating type, such as Panduit PDL-54 or PDL-56, or labels covered with clear heatshrink. Place labels at both ends of each cable, near the connectors so that the label is readable without removing wire ties.

2. Racks

- a. Label each rack as to general function (for example: "AUDIO RACK 1", "LECTURE HALL AV", etc.)
- b. For each group of racks, install a permanent label identifying:
 - 1) System Name.
 - 2) Owner.
 - 3) Designer.
 - 4) AV Subcontractor.

3. Equipment and Panels

- a. Clearly label input and output jacks and receptacles with engraved and paint-filled lettering. Labeling will include type of receptacle (MIC, LINE, AUX) and input number.
- b. Clearly label each item of equipment to identify indicate function. Also install labeling on rack mounted equipment to indicate function and normal setting of each control or switch. Where appropriate, normal settings may be marked using markers, self-adhesive drafting symbols or dots applied to the faceplate at the control pointer.
 - 1) Install labeling on each patch jack to indicate circuit or device (for example: "LECT" (lectern) on top jack, normaled to "MIC 1" (microphone input 1) on bottom jack

- c. Labels may be anodized, etched or directly engraved with paint-filled letters on the plate or panel being labeled. Other methods must be approved by the Consultant.
 - 1) 'Dymo' or 'Kroy' tape, and press-on labeling is not acceptable.
 - 2) Lamacoid labeling is not acceptable for IO connector panels. Securely fasten laminated plastic using screws, rivets, epoxy glue, or cyanoacrylate ("super-glue"); double stick tape or other types of glue are not acceptable.
 - 3) Labels for patch jacks shall be machine-printed paper labels, installed using manufacturer's standard hardware and protective covers.
- I. Programming
 - 1. General
 - a. Provide programming for complete, easy-to-use control of all AV equipment and related items.
 - b. Provide complete programming of programmable devices and controls, to form complete and operating systems with specified functionality, and functionality of each product fully implemented.
 - 1) Exact functionality and layouts of screens and panels subject to review and minor revisions and additions during submittal process, without an increase in the Contract amount.
 - c. At a minimum, base initial layouts/design on the Construction Documents.
 - d. Submit proposed programming for review and approval by Owner and Consultant. Include:
 - 1) DSP layouts and parameters. Include labeling and commenting for all objects, properties, and parameters.
 - 2) Layouts for button panels and touchscreens. Include:
 - a) Description of action for each button.
 - b) Graphical layouts, including artwork, button styles and colors.
 - e. Refer to Related Sections for additional requirements.
 - 2. DSP
 - a. For each loudspeaker output:
 - 1) Equalization (5 band parametric)
 - a) To optimize frequency response to maximize intelligibility and provide natural sounding speech.
 - 2) Hi and low cut (low pass and high pass)
 - 3) Crossovers, as required
 - 4) Limiters on all outputs to protect equipment from damage.
 - 5) Delay (may not be used on all outputs)
 - b. For each microphone input:
 - 1) Equalization (3 band parametric)
 - 2) Hi and low cut (low pass and high pass)
 - 3) Automatic level control
 - 4) Feedback suppression
 - a) Configure for up to 5 fixed filters, and 5 dynamic filters.

- b) Quantity and type of filters to be revised during final tuning.
 - c. Automatic microphone mixing where shown, or for groups of 4 or more microphones.
 - 3. Control System
 - a. At a minimum, include the following controls on touchscreens and button panels for indicated devices:
 - 1) Projection Screens
 - a) Screen Down
 - b) Screen Up
 - b. Video Projector
 - a) On
 - b) Off
 - c) Source Select (controls video switcher and projector input for all sources shown on block diagram)
 - c. Audio Volume:
 - 1) Up
 - 2) Down
 - 3) Include graphic depicting level setting in real time

3.3 SYSTEM STARTUP

- A. Testing and adjustment of equipment shall be performed by qualified technicians with prior knowledge of the particular items of equipment, and general knowledge of video and audio systems alignment and troubleshooting, and knowledge of the specific systems and installations of this project. Prior to the site visit by the Consultant, the Contractor shall perform preliminary measurements, testing and adjustments as follows:
- B. General:
 - 1. Test each and every device, input and output, to and from patch-bays, device to device, and point-to-point input panel to patch-point/device.
 - 2. Test ancillary equipment and loose items including, but not limited to ALS receivers, Wireless transmitters and receivers, patch cables and headsets.
- C. Loudspeakers:
 - 1. Measure and record impedance of each speaker load at the main junction box or rack cabinet, and total load on each amplifier. At a minimum, make measurements at 100, 1000, and 10,000 Hertz.
 - 2. Make corrections as required so that the load impedance of each amp is equal to or greater than rated load impedance.
 - 3. Slowly sweep all low frequency and full range speaker systems with sine waves at 25% of rated maximum amplifier power output, or at 50% of rated continuous power capacity of loudspeakers, whichever is less, from 20 to 2000 Hertz. Listen for symptoms of audible or tactile vibration of speaker components, mounting apparatus, or building elements. Under this Section, correct vibration or rattling of speakers or mounting apparatus to the satisfaction of the Consultant. Report vibration or rattling of other building elements to the Consultant; include frequency, characterization of observed rattling or vibration, and recommendations for corrections.

D. General Audio:

1. For each system, verify and adjust:
 - a. Signal polarity is correct for each circuit and path, and consistent for all circuits and paths. Reverse polarity if required, and record which circuit was reversed.
 - b. Verify that all microphones have the same polarity of output for positive pressure at diaphragm.
 - c. Verify that positive pressure at microphones produces positive pressure from each loudspeaker. Reverse polarity if required, and record which circuit was reversed.
 - d. Gain controls so all components except power amplifiers reach rated nominal output and onset of clipping at the same signal level (as system input).
 - e. Set audio distribution amplifiers for unity gain unless otherwise specified by the Designer.
 - f. Power amplifier gains so power amplifiers just begin to clip at the onset of clipping of the upstream device, plus 0 or minus 2 decibels.
 - g. Re-adjust gains if required for proper operation of each system and component, and to optimize normal operating and listening levels. Measure and record any such re-adjustments; also record the reason adjustment was deemed necessary.
 - h. Equalizers to optimize the specified frequency responses. Adjust notch filters to minimize "ringing" with open microphones; make adjustments with microphones in their normal operating positions.
 - 1) Perform final equalization and filtering of feedback modes in the presence of the Consultant.
 - 2) Microphones (when present):
 - a) All microphones have the same polarity of output for positive pressure at diaphragm.
 - b) Positive pressure at a microphone produces positive pressure from each loudspeaker. Reverse polarity if required, and record which circuit was reversed.
 - c) Automatic mixers, automatic level controllers, and other signal processors to optimize use of microphones for intended purpose using the expected (normal) microphone positions. Assume a voice level of 70 dB-SPL at 4 feet from the talker's mouth.
 - i. Verify that the system is completely free from hum, noise, parasitic oscillation, and RFI.
2. For each system, measure and record the following:
 - a. Overall frequency response and signal to noise throughout the entire listening area. Measure in 1/3 octave bands and include overall dBA and dBC values.
 - b. Perform tests with the measuring microphone at the seated ear height of the audience, within designated seating areas. All interior finishes and furnishings shall be in place during measurements.

- E. General Video:
1. Switchers and Processors
 - a. Input video test signal to each input of switcher and router, confirm proper routing and video quality at displays.
 2. Displays:
 - a. In addition to these specified requirements, comply with manufacturers recommendations for setting up and adjusting video displays.
 - b. Perform tests and adjustments using measuring equipment, do not rely entirely on subjective evaluation. Use the same test equipment that will be provided during Acceptance Testing; refer to list in the following section.
 - c. Warm-up lamps for at least 1 hour prior to measurements or adjustments.
 - d. Perform tests and adjustments separately for each format/scan rate to be used in the system, including at a minimum:
 - 1) Computer video at 1920 x 1200 pixels, for vertical refresh rates of 60 Hertz.
 - 2) ATSC video at 1080I, 1080P, and 2160P (if available).
 - 3) For devices which employ scaling, adjust so that images exactly fill the image area with minimal scaling and optimal resolution.
 3. Physical adjustments:
 - a. Where video projectors have mechanisms to change their position, operate the mechanism repeatedly between storage and operating position to verify exact positioning in operating position.
 - b. Adjust optical focus for maximum sharpness; for multiple lens/tube projectors, separately verify for each lens and primary color.
 4. Raster adjustments:
 - a. Verify/adjust for uniform illumination of each primary color.
 5. Light output:
 - a. Luminance level, per ANSI standard. Record all measured values (in each of 9 test areas) in addition to the average.
 6. Convergence/registration:
 - a. Within 1/2 pixel/line at center of picture, and 1 pixel at corners of picture, for all pairs of colors using grid of dots or lines.
 7. Geometry
 - a. Aspect ratio: image width to be within plus or minus 1 percent of image height times 1.78 (for 16:9 ratio) and 1.6 (for 16:10 ratio).
 - b. Image square, level, and plumb to the room and screen, within 1 percent of image size.
 - c. Test patterns of squares and circles to be square and round within 2 percent.
 - d. Overscan: For video signals: 4 to 6 percent, uniform on all four sides. For computer signals: zero overscan (image fills screen, and no pixels missing or off-screen).
 8. Gray Scale:
 - a. Luminance level within 10 percent of calculated ideal level, for each step of the gray scale pattern.

- b. Color temperature: 6500k for video signals and 9500k for computer signals, plus or minus 200K for each step of the gray scale pattern.
- 9. Picture quality adjustments:
 - a. Adjust with lighting set to the levels intended for viewing of video.
 - 1) Where light levels are variable for different types of viewing, make separate adjustments for each lighting level, stored to separate memories/presets.
 - b. White level ("contrast"): using 100 percent white signal, set to the highest value which achieves all of:
 - 1) No blooming
 - 2) No degradation of resolution, using needle pulse signal
 - 3) Luminance level of less than 50 foot-Lamberts or other maximum level as directed by Consultant
 - 4) Record measurements of the full white luminance level, the background lighting level at or on the screen, and resulting computation of contrast ratio.
 - c. Black level ("brightness", "picture"): using PLUGE signal:
 - 1) Standard black level (7.5 IRE for video) barely visible
 - 2) High black level (10 IRE for video) visible
 - 3) "Blacker than black" (5 IRE for video) not visible.
 - d. Chroma ("color", chroma gain), using SMPTE color bars and/or equivalent for computer video:
 - 1) As viewed in blue-only mode, or through a blue filter (Lee 47B), equal brightness of blue and gray bars.
 - e. Hue ("tint", chroma phase), using SMPTE color bars and/or equivalent for computer video:
 - 1) As viewed in blue-only mode, or through a blue filter (Lee 47B), equal brightness of cyan and magenta bars.
 - f. Peaking ("sharpness"):
 - 1) Adjust as directed by Owner.
- 10. Memories and presets:
 - a. Store values and parameters in presets and memories as directed by Owner.

3.4 CLEANING

A. General

- 1. Clean equipment and panels to remove plaster, taping or patching compound, overspray, paint spills, oil, grease, dust, fingerprints, or other dirt or contaminants to restore equipment to original finish and condition.
- 2. Remove dust, wire and insulation clippings, dirt and debris from the interior of enclosures, outlet boxes, pull and junction boxes, and equipment racks and cabinets.

3.5 CLOSEOUT ACTIVITIES

- A. Perform the following for project closeout of AV work:
 - 1. Obtain final electrical inspection.
 - 2. Perform initial testing, tests and documentation
 - 3. Provide nameplates and labeling on equipment.
 - 4. Refinish equipment finishes that are damaged.

5. Perform final cleaning.
6. Deliver Loose Items to Owner.
 - a. Deliver loose items, such as microphones, handheld remote controls and accessories, to Owner before the time of final acceptance.
 - b. Obtain the signature of Owner's representative acknowledging receipt of the loose items.
- B. Following completion of the above, submit written notice at least 10 days in advance so that Owner and Designer may at their respective discretion furnish representatives to witness and/or participate in the final tests and adjustments.
- C. Following Owner's and Designer's response to the above, perform final tests and adjustments as specified, and complete the following procedures.
 1. Submit and obtain acceptance of Record Documents.
 2. Submit and obtain acceptance of O & M Manuals.
 3. Provide training and instruction to Owner's personnel.
- D. Following completion of the above, submit a Final Acceptance Request. Assist Owner and AV Consultant in performing final acceptance testing and observing completion of the work. At Owner's and AV Consultant's option, any or all of the specified tests or adjustments, or additional tests or adjustments that may be deemed necessary by Owner or Designer, shall be repeated for observation.
- E. Completion Report
 1. Request for Acceptance Testing:
 - a. When the work is substantially complete, including Preliminary Testing and Adjustments specified above, and ready for final Demonstration and Acceptance Testing, submit request for acceptance testing to the Architect, Consultant, and Owner.
 2. Include:
 - a. Letters from the General Contractor and AV Subcontractor, on their respective letterheads, certifying that the AV systems are substantially complete, fully tested and adjusted, fully operational, and ready for inspection, final testing, and tuning.
 - b. Copies of final inspection certificates signed off by the Authority Having Jurisdiction.
 - c. Signed delivery receipt from Owner of delivered loose items.
 - d. Photographs of the completed installation. Include photographs of:
 - 1) An elevation view of the front wall of each room equipped with projection screen(s), showing the screen, loudspeakers, and other system elements.
 - 2) A view of each ceiling showing ceiling speakers and video projectors.
 - 3) A view of each equipment room, showing the equipment racks, backboards, terminal cabinets, and other installed materials.
 - 4) An elevation view of each equipment rack cabinet taken with the front door (if any) fully open, and a view of the interior of each equipment rack cabinet, taken from the rear with the door or rack fully opened.

- 5) An elevation view of each terminal cabinet, taken with the cover removed or fully opened.
- 6) A view of each type of wall-mounted device, including cameras, monitors, control panels, etc.
- 7) A "reflected ceiling" view of each loudspeaker cluster, and at least two separate side views of each loudspeaker cluster.
 - a) Loudspeaker cluster photographs shall be taken close-up, or with a telephoto lens, so that the cluster itself fills the image as much as possible.
 - b) Close-up views of typical attachments to the horns, low frequency boxes, cluster framework, and vibration isolators. These photographs may be taken during installation, prior to completion.
- 8) A view of each type of ceiling-mounted device, including loudspeakers, etc.
- 9) Close-up views of each type of input panel and output panel.
- 10) Close up views of each type of floor box/pocket with the covers open, and with the covers closed.
- 11) Professional photographs are not required; color "snapshots" are acceptable. Photographs may be digital. Photographs shall be legible, well-lighted, and well-focused, and composed to fill the image with the intended subject as much as possible.
- e. The results of all tests, measurements, and adjustments which are specified within this section and related sections.
 - 1) List of personnel and test equipment used.
 - 2) List of discrepancies and corrective action taken.
3. Submit the complete package of Completion Report to the Consultant for review prior to scheduling of the site visit by the Consultant for final observation and testing.
4. The AV Consultant will not schedule its site visit until the AV Subcontractor's Completion Report has been submitted and approved. Allow at least 10 calendar days between receipt of Completion Report by AV Consultant and the earliest desired date for site visit by AV Consultant. The AV Subcontractor is encouraged to communicate informally with the AV Consultant prior to submission of Completion Report to coordinate the scheduling of the AV Consultant's site visit.

3.6 DEMONSTRATION AND ACCEPTANCE TESTING

- A. Site Visit by Consultant
 1. Assist the Consultant in making final observations, demonstrations, tests, equalization, and other adjustments.
 2. AV Subcontractor and AV Consultant shall mutually perform acceptance testing and adjustments:
 - a. Demonstration and measurements to verify measurements and adjustments specified in the previous section, as selected by Consultant.

- b. Other measurements or demonstrations as requested by Owner, Consultant, or Installer.
 - 3. AV Subcontractor shall make any adjustments deemed necessary by Owner or Consultant, including but not limited to:
 - a. Re-aiming of loudspeakers.
 - b. Re-wiring of speaker taps.
 - c. Resetting of gain, slope, or other controls.
 - d. Addition or deletion of passive attenuators.
 - e. Changes in attenuator or tap values.
 - f. Changes in shielding or grounding, and addition or deletion of capacitors and/or resistors to grounding and shielding connections.
 - g. Minor changes in wiring and termination.
 - h. Changes in speaker aiming.
 - 4. Such work shall be included in the base bid contract amount.
- B. The Contractor shall make the following available (on-site) during the acceptance testing:
 - 1. General
 - a. The Contractor's personnel who participated in the installation and testing of the systems.
 - b. Copy of the Completion Report, including a list of discrepancies and corrective action.
 - c. Installation, servicing, and alignment manuals for all items of equipment furnished by Contractor
 - d. The draft (markup) "as-built" drawings, and product data submittals.
 - e. Software to adjust remotely controlled equipment, such as signal processors, with necessary computer and related hardware.
 - f. Provide sufficient cabling to permit controlling computer to be located in viewing and listening areas while signal processors remain in equipment cabinets and video projectors remain in normal operating positions.
 - g. Loose items (microphones and other accessories) needed to form a complete and operational system.
 - h. "Service-mode" remote controls.
 - i. Dual-trace, triggered oscilloscope with calibrated settings, and minimum bandwidth of 100 megahertz.
 - j. Sufficient patch cables and test cables to connect all IO of test equipment to all IO of installed equipment, in all possible combinations.
 - k. Hand tools, ladders, lifts, scaffolds sufficient to provide ready access to installed items, including ceiling loudspeakers and clusters.
 - 2. Audio
 - a. Sine wave oscillator with balanced output and distortion below 0.1%
 - b. AC voltmeter with 100 millivolt full-scale sensitivity and 50 to 10,000 Hertz frequency response
 - c. Distortion Analyzer, equivalent to Leader
 - d. Sound Level Meter, equivalent to Goldline SPL120.

- e. One-third octave real-time spectrum analyzer, or FFT analyzer, and calibrated microphone, equivalent to Ivie IE-45, SMAART with PC and calibrated microphone, or Goldline TEF.
 - f. Pink Noise generator, equivalent to Goldline.
 - 3. Video
 - a. Calibrated test signal device, equivalent to Extron VTG300R.
 - b. DisplayMate test pattern software for PCs
 - c. Digital Video Essentials test DVD
 - d. Color Analyzer, equivalent to Minolta CA-100 and/or CA-120
 - e. Light Meter, equivalent to Minolta T-10 or T-1
 - 4. Consultant may request submittal of documentation of calibration.
- C. Additional Site Visits by AV Consultant
 - 1. Additional site visits may be deemed necessary by the AV Consultant if any of the following conditions are found during the (initial) site visit:
 - a. Manuals or required information not available.
 - b. Items of equipment (including loose items) that are not available or non-operational.
 - c. Items of equipment which do not meet the specifications, or the manufacturers' published performance criteria.
 - d. Hum, buzz, or noise which degrade the signal to noise ratio of any circuit by more than 5 decibels from the manufacturer's rated signal-to-noise ratios for noisiest upstream component.
 - e. Audio distortion which is audible, or video distortion which is visible.
 - f. Any other conditions which are not in accordance with the specifications, drawings, Contractor's submittals, or Completion Report.
 - 2. The AV Subcontractor shall make every possible effort, and the AV Consultant will render reasonable assistance which does not hamper the other work of the site visit or extend the site visit, to correct the deficiencies during the site visit to avoid additional site visits.
 - 3. If additional site visits are deemed necessary:
 - a. The AV Consultant will submit a written notification of the reasons with descriptions of the deficiencies to be corrected.

3.7 TRAINING

- A. After the final Demonstration and Acceptance Testing, the AV Subcontractor shall instruct the personnel designated by the Owner in operation and routine maintenance of the systems.
 - 1. Schedule in coordination with the Owner and AV Consultant.
 - 2. Prior to or at the first training session, provide a draft copy of the Operations Manual to the trainees.
 - 3. Contractor's trainers shall include superintendents or foremen who installed and configured the systems. Trainers shall also include manufacturers' representatives when so specified, or as appropriate.
- B. The training sessions should cover the following areas:
 - 1. General operation of all systems and functions.
 - 2. Explanation and orientation of all technical documentation.
 - 3. Explanation of signal flow including all signal paths through routing switchers and patching.

4. Basic system troubleshooting and preventive maintenance.
 5. Explanation of system warranty, including procedures to obtain support from Contractor.
- C. At a minimum, provide the following sessions of training for systems users, covering operations. Each session shall be for at least the specified number of hours and number of attendees per session.
1. General: at least two sessions of four hours each, for up to 6 persons each, for operations and management staff.
 2. Technical: at least one sessions of six hours each, for up to 4 persons each, for AV technical staff, covering detailed operations and maintenance.
 3. At least one session (as selected by Owner) shall include operating each system during an actual event.
 4. At the completion of installation, submit a written request to the Owner to schedule the training sessions, at least two weeks in advance of the requested dates.
- D. At least one of each type of class (as selected by Owner's representative) shall be video recorded by the contractor. Professional "talent" or equipment is not required. Deliver at least one electronic copy to the Owner.

END OF SECTION

SECTION 27 41 10
AV SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes the following AV systems:
 - 1. Community Room.
 - 2. Conference Room.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 26 05 90: Electrical Requirements for AV systems.
- C. Section 27 41 00 Basic Means and Methods for AV.

1.3 SYSTEM DESCRIPTIONS

- A. Community Room
 - 1. Wireless speech reinforcement.
 - 2. ...
- B. Conference Room
 - 1. Infrastructure for future flat panel display.

1.4 PERFORMANCE REQUIREMENTS

- A. Audio output capability: Minimum sound pressure level in decibels A-weighted throughout the seating area, measured at typical seated listener's ear level with less than 5% acoustic harmonic distortion, when driven with continuous pink noise. When driven in excess of maximum output, clipping shall occur first in the power amplifiers.
 - 1. Community Room: 88 dBA
- B. Audio frequency response: measured acoustically at typical seated listener's ear level in contiguous one-third octave bands: within plus or minus 2 decibels of flat from Lower Limit to Knee frequency, then rolling off at 3 decibels per octave to Upper Limit, in Hertz.
 - 1. Community Room:
 - a. Lower Limit: 80
 - b. Knee: 2,500
 - c. Upper Limit: 16,000
- C. Audio noise: system noise shall not exceed an equivalent input noise of -120 dBm (20,000 Hertz bandwidth). Use of any system control shall not produce audible clicks, pops, thumps, or spurious noises.
- D. The AV Consultant shall be the sole judge of these criteria having been met.

PART 2 PRODUCTS

2.1 RACKS AND ACCESSORIES

- A. Swing-out Equipment Racks
 - 1. Middle Atlantic EWR-series or approved equal.
- B. Stand-alone Equipment Rack (RK1)
 - 1. Middle Atlantic WRK-series or approved equal.
- C. Vent Panels for 19" Equipment Cabinets
 - 1. Middle Atlantic or approved equal.
- D. Blank Panels for 19" Equipment Cabinets
 - 1. Middle Atlantic or approved equal.

2.2 TERMINATION DEVICES

- A. Plate Mounted Audio Connectors
 - 1. Description: audio connectors.
 - 2. Specifications:
 - a. Locking hatch.
 - b. Metal shells.
 - c. Provide configurations and styles as indicated on drawings.
 - 3. Manufacturer: Neutrik or approved equal.
- B. Plates for Receptacles
 - 1. Description: metal plates for wall-mounted audio receptacles, to mount on standard "gang" electrical boxes.
 - 2. Specifications:
 - a. Material: 1/8" Aluminum- no exceptions.
 - b. Finish: brushed.
 - c. Provide styles and sizes as shown on drawings.
 - d. Nomenclature: Anodized, etched, directly engraved or as approved by Consultant.
 - 3. Manufacturer: ProCo, RCI, Soundolier, Sierra, RDL, or approved equal.
- C. Terminal Blocks
 - 1. Description: Enclosed screw-type terminal blocks for use without spade lugs.
 - 2. Specifications:
 - a. Enclosed screw terminals.
 - b. Numbered or labeled terminals.
 - c. DIN rail mounting.
 - d. Modular construction.
 - 3. Manufacturer: Phoenix Contact, or approved equal.
- D. Punch Blocks for stranded conductors
 - 1. Description: Punch blocks rated by the manufacturer for use with stranded wires.
 - 2. Specifications:
 - a. High pressure insulation displacement type.
 - b. Rated by the manufacturer for use with stranded wires.
 - c. Terminate wires only with the tools designed for the specific type of punch block.
 - d. Punch blocks designed for use with solid wires, such as standard "66B" or "110" types, are not acceptable for use with stranded wires.
 - 3. Manufacturer: ADC, or approved equal.

- E. Punch Blocks for solid conductors
 - 1. Description: punch blocks for solid conductors.
 - 2. Specifications:
 - a. Standard "66B" type or "110" type.
 - b. Use only with wire gauges for which terminals are rated.
 - 3. Manufacturer: Siemon, Ortronics, Leviton, or approved equal.

2.3 CONDUCTORS

- A. Wire and Cable
 - 1. Provide wire and cables that are listed by UL or other agency acceptable to the AHJ, and marked for their Class of wiring, per NEC.
 - a. Prior to installing wire or cable furnished by Owner or others, verify listing and marking to be in compliance with NEC and acceptable to AHJ.
 - 2. Trade numbers shown within this document may be for general-purpose cables for use in raceway and where otherwise allowed by NEC and other codes.
 - a. Provide wet, riser or plenum rated versions where shown or specified.
 - b. Where wet, riser or plenum cable is not shown or specified, for each installation situation verify prior to installation with the local authority having jurisdiction that dry, non-plenum and non-riser rated cables are acceptable.
 - 1) In the event that the AJH requires wet, plenum or riser-rated cables, provide cables so rated with equivalent electrical characteristics to those specified below. Contractor will be reimbursed for any increase in actual cost of materials over the specified materials due to changing to wet/riser/plenum rating.
- B. Shielded Twisted Pair (STP, M, L, INT)
 - 1. Description: Miniature shielded twisted pair cable for microphones, line-level audio circuits, intercom circuits, and other circuits.
 - 2. Specifications:
 - a. Conductor size: #22 AWG, tinned stranded copper.
 - b. One twisted pair per cable.
 - c. Folded foil shield.
 - d. Jacketed.
 - e. UL listed.
 - 3. Manufacturer: Belden 8451, West Penn 452, or approved equal.
- C. Large Speaker Cable (SP4, SP8, DC)
 - 1. Description: Heavy gage cable for Class 2 low impedance (less than 20 ohm) or long run loudspeaker circuits, and for Class 2/3 DC power to devices.
 - 2. Specifications:
 - a. Conductor size: #12 AWG, stranded copper.
 - b. One twisted pair.
 - c. Unshielded.
 - d. Jacketed.
 - e. UL listed.

3. Manufacturer: Belden 8477, Belden 5500FE, West Penn 227, or approved equal.
- D. Small Speaker Cable (S70)
 1. Description: Light gage cable for Class 2 high impedance (70 volt) or short run (less than 10 feet) loudspeaker circuits.
 2. Specifications:
 - a. Conductor size: #18 AWG, stranded copper.
 - b. One twisted pair.
 - c. Unshielded.
 - d. Jacketed.
 - e. UL listed.
 3. Manufacturer: Belden 8761, Belden 9740, Belden 5300FE, West Penn 224, or approved equal.
- E. Class 1 Speaker Cable (SP4, SP8, S70)
 1. Speaker cable for Class 1 circuits for 4-16 ohm loudspeakers shall be Belden 9489, Belden 3103A, Belden 9344, pairs of THHN, or approved equal.
 - a. For THHN wires, twist pairs together. Wires do not need to be twisted within conduits.
 2. Speaker cable for Class 1 circuits for 70-volt loudspeaker lines shall be Belden 9486, Belden 9341, Belden 1120A, Belden 3088A, or approved equal.
- F. Control Cable (C, CC, CTLA)
 1. Provide type STP as specified above.
- G. SPDIF Cable
 1. Description: coaxial cables for baseband video circuits.
 2. Specifications:
 - a. Conductor size: #20 AWG, solid copper center conductor.
 - b. Trade Size: RG59/U.
 - c. Nominal Impedance: 75 ohms.
 - d. Duo-foil shield with +95% tinned copper braid.
 - e. Nominal Velocity of Propagation: 83%.
 - f. UL listed CMR.
 3. Manufacturer: Belden 1505A or approved equal.
 - a. At the option of the Contractor, for multiple cables per run: Belden 779xA-series (jacketed bundles of 1505A), or approved equals.
- H. CAT6 Cable (CAT, CAT6, UTP)
 1. Provide shielded Category 6 data cable and accessories of types specified in other Sections of Division 27 for Horizontal High-speed Data Cable.
- I. Large Antenna Cable (A, ANT)
 1. Description: Low Loss RF Transmission Cable for use with UHF Wireless Systems.
 2. Specifications:
 - a. Conductor size: #10 AWG, solid copper center conductor.
 - b. Trade Size: RG-8
 - c. Nominal Impedance: 50 Ohms
 - d. Duobond shield with +90% tinned copper braid.
 - e. Nominal Velocity of Propagation: 84%.

- f. UL listed.
 - g. Provide for runs over 50 feet in total length from antenna to receiver.
 - 3. Manufacturer: Belden 9913F, or approved equal.
- J. Small Antenna Cable (A, ANT)
 - 1. Description: RF Transmission Cable for use with UHF Wireless Systems, for short-run (total length of cables less than 150 feet) antenna circuits.
 - 2. Specifications:
 - a. Conductor size: #20 AWG, solid copper center conductor.
 - b. Trade Size: RG-58/U
 - c. Nominal Impedance: 50 ohms.
 - d. Shield with +95% tinned copper braid.
 - e. Nominal Velocity of Propagation: 66%.
 - f. UL listed.
 - 3. Manufacturer: Belden 8240, or approved equal.
- K. DC Power Wiring (DC)
 - 1. Description: wiring for Class 2 and Class 3 power supply outputs.
 - 2. Specifications:
 - a. Pairs of #12 AWG THHN.
- L. HDMI Cables
 - 1. Description: Cables for connecting HDMI interfacing.
 - 2. Specifications:
 - a. Assemblies with factory-installed connectors.
 - 3. Manufacturer: Blue Jeans BJC Belden Series-1 or approved equal.

2.4 AUDIO EQUIPMENT

- A. ALS Systems
 - 1. Description: FM/Wi-Fi hybrid assistive listening system kit
 - 2. Specifications:
 - a. Dipole antenna, wall mount
 - b. Four (4) Receivers, or as needed
 - c. Charging kit
 - d. Ear speaker option
 - e. Bodypack option w/neck loops, 2 minimum
 - f. ADA-compliant wall plaque
 - 3. Manufacturer: Williams FM 557 Pro Kit with Antenna ANT 024 or approved equal.
- B. AV I/O Plate Type 1 (AV1)
 - 1. Description: ~~HDMI Floor Box~~ Future AV Input Plate
 - 2. Specifications:
 - a. ~~Two~~ 1-Gang ~~openings reserved for AV use.~~
 - 3. Manufacturer: ~~For future use.~~ Extron DTP T HWP 4K 231 D or approved equal.
- C. AV I/O Plate Type 2 (AV2)
 - 1. Description: ~~AudioControl panel~~ input plate
 - 2. Specifications:
 - a. ~~22-G~~gang ~~wall box~~
 - 3. Manufacturer: ~~Legrand~~ Qsys Attero Tech unD6IO-BT or approved equal.
- D. AV I/O Plate Type 3 (AV3)

1. Description: Projector ceiling output plate
 2. Specifications:
 - a. ~~4" octagon box or similar for AV1-Gang~~
 3. Manufacturer: ~~Legrand~~ Extron DTP R HWP 4K 231 D or approved equal.
- E. AV I/O Plate Type 4 (AV4TX & AV4RX)
1. Description: AV HDMI & Audio ~~Input plate~~ Transmitter & Receiver
 2. Specifications:
 - a. ~~1-Gang with Decora insert cutout for HDMI/Audio~~ TX: HDBaseT transmitter with HDMI and audio inputs, HDBaseT output
 - b. ~~2-Gang with Decora insert cutouts for Bluetooth audio~~ RX: HDBaseT receiver with HDMI and RS232 outputs at future display location.
 3. Manufacturer:
 - a. ~~TX: Extron DTP T HWP 4K 231 D Decora transmitter with DTP HDMI 4K 230 Rx Receiver~~ AV ProEdge AC-CXWP-HDMI-T or approved equal.
 - b. ~~Q-Sys Attero Tech unD6IO-BTRX~~ AV ProEdge AC-EX70-444-RNE-P or approved equal.
- F. AV I/O Plate Type 5 (AV5)
1. Description: Surround sound output plate (ADDITIVE ALTERNATE #1)
 2. Specifications:
 - a. 1-gang wall box w/ rubber grommet and pullstring for future use
 3. Manufacturer: Legrand or approved equal.
- ~~G. AV I/O Plate Type 6 (AV6)~~
- ~~0. Description: Projection screen power interface~~
- ~~0. Specifications:~~
- ~~See projector low voltage controller details~~
- ~~0. Manufacturer: Legrand or approved equal.~~
- ~~L.G.~~ Pendant Loudspeaker Type 1 (P1)
1. Description: Pendant Loudspeaker.
 2. Specifications:
 - a. 2-way coaxial drive compliment.
 - b. 6.5" woofer.
 - c. 8-ohm nominal impedance.
 - d. 70v transformer
 - e. 100W continuous power handling @8ohm.
 3. Manufacturer: Biamp Community DP6 or approved equal.
- ~~M.H.~~ Digital Signal Processor
1. Specifications:
 - a. Dante compliant inputs
 - ~~1.2.~~ Manufacturer: Biamp Community ALC-404D, ~~or~~ Biamp TesiraFORTE DAN AI, or approved equal.
- ~~N.I.~~ Power Amplifiers
1. Manufacturer: Biamp Community ALC-404D, or approved equal.
- ~~O.J.~~ Rack Drawer
1. Description: Lockable rackmount drawer.
 2. Specifications:
 - a. 2U height.
 - b. 16" depth.

- c. Black.
 - 3. Manufacturer: Middle Atlantic Products D2-LK or approved equal.
- P.K. Wireless Microphone Receiver
 - 1. Manufacturer: Sennheiser EM 100 G4 or approved equal.
- Q.L. Wireless Antenna System
 - 1. Manufacturer: Sennheiser ASA 214-UHF splitter with A2003-UHF antennae or approved equal.

2.5 VIDEO EQUIPMENT

- 1. Description: Surface-mounted, electrically-operated, motorized mechanism for projection screens, for mounting on walls or ceilings, with large roller to support large screens.
 - 2. Specifications:
 - a. Image area (excluding masking borders and drop): 79" x 140" (161" diagonal)
 - b. Matte White 1.0x Screen Gain
 - 3. Manufacturer: Draper Targa 116023 projection screen or approved equal.
- B. Video Projector Type 1 (VP1)
 - 1. Description: Video projector.
 - 2. Specifications:
 - a. 7,000 ANSI lumens.
 - b. Native resolution: 1080p
 - 3. Manufacturer: Panasonic PT-RZ770 with ET-DLE105 or approved equal.
- C. Projector Mount
 - 1. Description: Ultra short-throw projector mount and equipment enclosure.
 - 2. Manufacturer: Legrand Chief VCMU with CMA110 and CMSXXX (length as needed), or approved equal with 1.5" NPT Column to structure.
- D. Video Switcher
 - 1. Description: PVT-DTP-enabled 8x2 Matrix Video Switcher.
 - 2. Manufacturer: Extron PVS 407D-DTP2 CrossPoint 82 or approved equal.
- E. Wireless Presentation Device
 - 1. Description: Wireless AV presentation device
 - 2. Specifications:
 - a. HDMI output with embedded audio
 - b. Wireless gateway option with LAN port
 - 2.3. Manufacturer: Barco Clickshare C-10 or approved equal

2.6 CONTROL EQUIPMENT

- A. Touchscreen Control Panel (TP1)
 - 1. Description: IP touch screen.
 - 2. Specifications:
 - a. 7" display size.
 - b. TFT active matrix color LCD.
 - c. Projected capacitive, 5-point multitouch capable
 - 3. Manufacturer: Crestron TSW-770-B-S or approved equal.
- B. Controller Processor
 - 1. Description: IP rackmount controller.
 - 2. Specifications:

- a. 100BaseT connectivity.
- b. Supports RS-232, 422, 485 connectivity.
- c. Supports 1-way IR/serial control.
3. Manufacturer: Crestron CP3 or approved equal.

2.7 NETWORKING EQUIPMENT

- A. PoE Switch
 1. Description: PoE network switch
 2. Specifications:
 - a. 24 RJ45 ethernet ports.
 - b. 2 SFP ethernet ports.
 - c. 10/100/1000 Mbps port speeds.
 - d. Dante protocol compliant.
 3. Manufacturer: Ubiquiti EdgeSwitch 24 or approved equal.

2.8 LOOSE ITEMS

- A. Wireless Lavalier Microphone
 1. Manufacturer: Sennheiser SK 100 G4 or approved equal.
 2. Quantity: Two.
- B. Wireless Handheld Microphone
 1. Manufacturer: Sennheiser SKM 100 G4 or approved equal.
 2. Quantity: Two.
- C. Assistive Listening System Receivers
 1. Manufacturer: Williams PPA R37N with charging station, or approved equals.
 2. Quantity: four or four percent of maximum room occupancy, whichever is greater.

2.9 ACCESSORIES

- A. Screen control switch (SW)
 1. Provide low voltage control switch assembly.
- B. Cable Lubricants
 1. Electrical cables: Dyna-Blue, American Polywater.
 2. Fiber-optic cables: Optic-Lube, Ideal.
- C. Glass Fiber Batting
 1. Description: Glass fiber batting for speaker enclosures.
 2. Specifications:
 - a. Unfaced (without vapor barrier).
 - b. Non-rigid batting, cut to size as required.
 - c. Density: 0.75 pound per cubic foot, minimum.
 3. Manufacturer: Knauf, Owens Corning, Johns Manville, or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with Section 274100 except as otherwise specified in this Section.

END OF SECTION

REPORT OF GEOTECHNICAL ENGINEERING SERVICES

King County Housing Authority
Kirkland Heights Improvements
Kirkland, Washington

For
King County Housing Authority
May 15, 2023

Project: KCHA-38-04



May 15, 2023

King County Housing Authority
Capital Construction Department
600 Andover Park West
Seattle, WA 98188

Attention: Gordon Ericksen

Report of Infiltration Testing Services

King County Housing Authority
Kirkland Heights Improvements
13310 NE 133rd Street
Kirkland, Washington
Project: KCHA-38-04

NV5 is pleased to submit this report of geotechnical engineering services for the proposed improvements to the Kirkland Heights Apartments located in Kirkland, Washington. This report has been prepared in accordance with the Subcontract for Professional Services dated December 21, 2022.

We appreciate the opportunity to be of service to you. Please contact us if you have questions regarding this report.

Sincerely,

NV5

Kevin J. Lamb, P.E.
Principal Engineer

KJL:kt

Attachments

One copy submitted (via email only)

Document ID: KCHA-38-04-051523-geor.docx

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05/15/2023

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ACRONYMS AND ABBREVIATIONS

ACP	asphalt concrete pavement
BGS	below ground surface
BMP	best management practice
CEC	Cation exchange capacity
CMU	Concrete masonry unit
DOE	Washington State Department of Ecology
GIS	Geographic Information System
GPS	global positioning system
HMA	hot mix asphalt
KCSWDM	King County Surface Water Design Manual
LID	low-impact development
meq	milliequivalent
RMGW	Richard Martin Groundwater
UIC	Underground injection control well
WWSMM	Western Washington Stormwater Management Manual

1.0 INTRODUCTION

This report presents the results of NV5's geotechnical engineering services to support design of stormwater management using infiltration as a part of the Kirkland Heights improvements project. Recent explorations completed in the east portion of the site encountered dense glacial till soils to depths of 20 feet that are underlain by glacial outwash deposits. Infiltration tests within the glacial till soils indicated infiltration of stormwater was not feasible at shallow depth. Current design plans include up to three detention vaults as part of the stormwater management system.

The glacial outwash encountered below the till is expected to have a high infiltration potential and may support the use of Underground Injection Control wells (UIC's) as an alternative stormwater management method. UIC's, with diameters of 18 to 36-inch diameters, would be more economical to install and have less construction impacts than those associated with detention vaults.

Additional subsurface exploration was required to explore the horizontal and vertical extent of the glacial outwash deposits on site and to conduct in situ well tests to determine if UIC's are feasible, and if they will provide adequate capacity for stormwater management as an alternative to the large detention vaults.

The site location relative to surrounding physical features is shown on Figure 1. The approximate locations of our explorations are shown on Figure 2. Figure 3 presents a geologic cross section of the interpreted geology underlying the site. Figure 4 presents a summary of groundwater level monitoring.

Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 SCOPE OF SERVICES

The purpose of our geotechnical engineering services was to provide geotechnical support to evaluate the feasibility of Underground Injection Control Wells (UIC's) and provide design recommendations for them to manage stormwater flows from the Kirkland Heights Apartments. Our specific scope of services is summarized as follows:

- Review available design reports, preliminary plans, and geotechnical information for the project.
- Coordinate and manage the field explorations, including public utility locates and scheduling contractors and NV5 staff.
- Complete five borings between 25.8 and 80.9 feet BGS, using auger and rotosonic drilling methods.
- Installed three 2-inch diameter PVC groundwater monitoring wells, and one 4-inch diameter PVC well in the borings.
- Subcontract with our hydrogeologist Richard Martin Groundwater, LLC to:

- Perform an in-situ infiltration test within the 4-inch diameter well.
 - Evaluate infiltration feasibility using UIC's and treatment capacity.
 - Evaluate the groundwater mounding potential.
 - Evaluate potential for seepage to develop in areas downslope of the infiltration area.
 - Estimate aquifer parameters.
- Provide this report summarizing our findings, conclusion, and recommendations addressing:
 - Subsurface soil and groundwater conditions
 - Feasibility of infiltrating stormwater using UIC's
 - Long-term design infiltration rate/hydraulic conductivity rate to support UIC design.
 - Groundwater mounding potential
 - Potential impact of infiltration
 - Geologic hazardous Areas
 - Slope stability impacts
 - Impacts on adjacent/downstream properties.

3.0 SITE CONDITIONS

We observed the existing conditions during site visits to mark the boring locations, to check utility locations, and to complete the subsurface explorations. Subsurface conditions were evaluated by completing four subsurface explorations within the project area.

3.1 SURFACE CONDITIONS

The site is located on the upland drift plain west of the Sammamish River Valley. The ground surface within the site area has a gradual slope to the south. The site is developed approximately 25 two-story apartment buildings separated by grass lawn areas and asphalt paved parking areas between the buildings.

The area was previously used for agricultural purposes up until construction of the existing complex in the early 1970s. The ground surface across the site slopes gradually south with a change in elevation of approximately 35 feet over a horizontal distance of 670 feet. Level pads for the building have been constructed on the slope through shallow cuts and embankment fills. The buildings are supported on grade with portland cement concrete floor slabs. All utilities are underground.

3.1.1 Geologic Critical Areas

We reviewed the City of Kirkland GIS Map of Geologic Critical areas for the site and adjacent areas, Figure 5. The geologic critical areas shown on the GIS map are the result of slope determination algorithms that broadly identify areas based on topography determined from small scale GIS mapping. There are three small areas identified along the perimeter of the site indicated as having a "Moderate Susceptibility to Landslide." Each of these areas have short rockeries approximately 4-feet in height that have been constructed along the property line and have been incorrectly identified as a geologic hazard area. The face of the rockeries is steeper than 40%, however, they are less than 10-feet in height, and do not meet the geometric or geologic criteria for "High Landslide Hazard Areas" or for "Moderate Landslide Hazard Areas".

Based on our surface observations and geologic reconnaissance the site does not contain any areas that meet the City of Kirkland Zoning Code Chapter 85 definition of Geologically Hazardous Areas. The geologic hazard areas on properties adjacent to the site, identified on the GIS map, are similarly misidentified, as they contain rockeries or small CMU block retaining walls, less than 10-feet in height, or have been regraded during recent development activities.

3.2 SUBSURFACE CONDITIONS

We previously completed a geotechnical investigation to support a project located in the southeast corner of the property (NV5, 2022). During that investigation six borings (B-1 through B-6) were completed to explore conditions to provide geotechnical recommendations for development. Boring B-6, of the geotechnical investigation, encountered glacial outwash material that resulted in additional explorations being completed for this phase of the project.

Subsurface conditions were explored during this phase, within the proposed vault areas, by completing five drilled borings (B-7 through B-11) that included four hollow stem auger and one rotosonic boring to depths between 25.8 and 80.9 feet BGS. The boring locations are shown on Figure 2.

A description of the field explorations and the exploration logs are presented in Appendix A. The results of the in-situ well testing is provided in Richard Martin Groundwater LLC report which is included in Appendix B. Laboratory test results for CEC and Organic Matter Content tests, completed by AmTest, are provided in Appendix C.

Borings B-7 through B-9 were completed through the HMA pavement, boring B-10 was completed on the edge of a gravel parking lot and boring B-11 was completed in a grassy landscaped area.

Standpipe piezometers, 2-inches in diameter, to monitor groundwater levels, were constructed in borings B-7, B-9, and B-10. A 4-inch diameter well was constructed in boring B-11 for the purpose of in-situ infiltration testing. Generally, subsurface conditions encountered during our field investigation are consistent with available geologic mapping of the area (Minard 1983 and Brooks 2017), and with previous borings drilled on site.

The subsurface conditions are described below, and an interpretive cross section of the conditions encountered is provided in Figure 3.

3.2.1 AC

Asphalt concrete pavement is present at the ground surface at boring locations B-7 through B-9. The pavement ranges in thickness from 2.5 to 3.0 inches. Aggregate base varying in thickness from 3 to 6 inches is present below the pavement.

3.2.2 Fill

Fill is present beneath topsoil in borings B-10 and B-11 to a depth of 4.5 and 3 feet BGS, respectively. The fill consists of moist, brown to gray silty sand with gravel. The sand and gravel within the deposit varies from fine to coarse.

3.2.3 Glacial Till

Glacial till is present beneath the fill or pavement structure in all borings at depths ranging from 12 to 22 feet BGS. The glacial till encountered in the explorations generally consists of dense to very dense deposits of silty sand with gravel with varying amounts of sand and gravel.

Weathered glacial till was encountered in borings B-7 and B-10 to a depth of 7 and 9.5 feet, respectively.

3.2.4 Advance Outwash

Glacial advance outwash is present beneath the glacial till borings in all borings ranging in depth from 12 to 22 feet BGS and extending to the termination depth of each boring. The glacial advance outwash encountered in the explorations generally consists of medium dense to very dense deposits of sand with variable silt and gravel content. Glacial advance outwash was generally brown and gray with fine to coarse sand and gravel.

A lens of clay was encountered within the outwash material in boring B-10 between 61 feet to 64 feet BGS. Based on SPT blow counts, the clay is classified as hard.

3.3 GROUNDWATER

Groundwater monitoring wells were installed in borings B-7, B-9 and B-10 consisting of 2-inch diameter PVC. A 4-inch diameter PVC well was installed in boring B-11 for the purpose of infiltration testing performed by Richard Martin Groundwater, LLC. Monitoring well construction details are presented with the boring logs provided in Appendix A.

A wet soil zone was encountered during drilling of boring B-10 at a depth of 60 feet BGS.

Pressure transducers with dataloggers were placed in the standpipe piezometers in borings B-7, B-9 and B-10 to collect automated groundwater measurements. Boring B-7 remained dry, and no data was recorded. Groundwater is present in B-9 and B-10, at depths of approximately 76 to 80 feet BGS or between Elevations 32 to 252, as shown on Figure 4.

3.4 IN-SITU TESTING

Infiltration tests were performed in B-11, which was completed to a depth of 65 feet and was terminated within the glacial advance outwash. A 4-inch diameter standpipe piezometer (well) was installed in the boring, DOE Well Tag ID BNL 828. The well construction is shown on the summary log provided in Appendix A, and summarized below:

- Bottom of well 65 feet
- Well screen 0.010-inch slot installed between 20 and 60 feet BGS
- Filter sand pack 12/20 grain size between 17.5 to 60 feet BGS

A hydrant permit was acquired for the test. The test consisted of a controlled filling of the well with the goal of the test is to establish a flow rate that maintains a steady water level in the well. Additional details on the infiltration test procedures along with test results and analyses are presented in the summary report by Richard Martin Groundwater LLC, provided in Appendix B.

4.0 LABORATORY TESTING

Laboratory tests were conducted on select soil samples from the explorations to assist in the characterization of certain physical parameters of the soil. Index tests that were performed included the determination of natural water content, fines content analysis, and grain-size distribution analysis. All tests were conducted in general accordance with appropriate ASTM standards (ASTM, 2016). A discussion of laboratory test methodology and the test results are presented in Appendix A. Test results are also displayed where appropriate on the exploration logs presented in Appendix A.

4.1 CEC AND ORGANIC CONTENT

CEC and organic content tests were completed on samples of the glacial outwash deposits where infiltration is being proposed to help evaluate soil capacity for water quality treatment. The CEC tests and organic content tests were performed by Specialty Analytical. Tests were completed on samples at depths between 21 to 37 feet within the depth interval where infiltration will occur. The test results are summarized in Table 2.

Table 2. CEC and Organic Content Analytical Results Summary ¹

Exploration	Sample Depth (feet BGS)	Soil Type	CEC (meq per 100 grams)	Organic Content (percent)
B-7	29 to 30.5	Brown sand with silt (SP-SM)	3.7	1.4
B-7	44 to 46.5	Brown-gray sand (SP)	2.1	1.1
B-9	35-36.5	Gray sand with silt (SP-SM)	3.0	1.3
B-9	40 to 41.5	Gray sand with silt (SP-SM)	3.2	1.1
B-10	30 to 31.5	Gray sand with gravel (SP)	3.1	1.3
B-10	40 to 41.5	Gray sand with gravel (SP)	3.0	1.3

1. Suitability for Water Quality Treatment: CEC greater than or equal to 5 meq per 100 grams and organic content at least 1 percent (SWMMWW, 2019)

The analytical laboratory test report of the CEC and organic content test results is presented in Appendix C.

5.0 CONCLUSIONS

The proposed detention vault areas are underlain by glacial till that is underlain by glacial advance outwash. Infiltration of stormwater into the glacial advance outwash is feasible. The primary receptor unit is the glacial outwash material, composed primarily of sand and silty sand.

The approximate depth to the top of the outwash is expected to be approximately 22 feet at most locations, however, at the northwest vault location, the depth to the top of the glacial outwash layer varied from 12 to 22 feet, as encountered in B-7 and B-8, respectively. We recommend anticipating that the glacial till extends to a depth of 22 feet in the design of UIC's.

All the borings were terminated within the glacial outwash deposit at depths up to approximately 81 feet. A vertical separation of 15 feet is required below the bottom of the UIC's and groundwater. Groundwater levels on site were measured at depths between approximately 76 to 80 feet BGS. The thickness of the outwash deposit available for infiltrating stormwater extends from a depth of 22 feet to 62 feet, to maintain the vertical separation between the assumed depth to groundwater.

The glacial advance outwash and transition bed deposits are considered to have "Low" treatment capacity in accordance with Table I-4.2 (WWSMM, 2019). This classification is based on:

- The deposit extends a minimum of 15 feet below the base of the well and seasonal high groundwater.
- The soil is typically described as sand as indicated on the summary logs,
- Grain size analyses provided in Appendix A indicate the material average grains size is between 0.125 to 4 mm, and
- CEC value is typically less than 2meq per 100 grams, and organic matter contents are less than 0.5%, as indicated in Table 2 and Appendix C.

The infiltration test was completed in the 4-inch diameter test well that is installed in B-11. The well extends to a depth of 65 feet and is screened from a depth of 20 to 60 feet BGS, with a sand pack from 17.5 to 65 feet BGS. The screened interval is within the glacial advance outwash. The test procedure and results are described in the RMGW report provided in Appendix B.

Initial flow was approximately 90 gpm, which decreased during the test to a near steady state rate of approximately 48 gpm in the 4-inch diameter well. Infiltration of stormwater at the site is feasible.

Single or multiple UIC's and alternative infiltration systems, which include drilled drains, or proprietary Maxwell Plus Dry Wells, can be designed to accommodate the required design flow rate at each vault or source location. Based on the well test analysis and groundwater mounding analysis deep infiltration systems capable of providing the stormwater management at the site include:

- UIC's installed to a depth of 60 feet,
- Drilled Drains installed to a depth of 45 feet,
- Maxwell Plus Dry Wells (proprietary) and installed to a depth of 45 feet.

The Richard Martin Groundwater LLC report provided in Appendix B provides a summary of the well testing, infiltration capacity, and recommended flow rates for use in design of UIC's, Drilled Drains, and Maxwell Plus Dry Wells. The deep infiltration systems are similar with regards to

infiltration, and all are limited to a depth of 60-feet in order to maintain a 15-foot separation from seasonal high groundwater levels.

5.1 INFILTRATION METHODS

Alternative infiltration systems that are feasible for the site, including UIC's, are described below.

5.1.1 UIC's

UIC's are small diameter wells, typically varying from 8 to 12-inches in diameter, constructed like water wells, with a well screen and filter pack within the identified receptor unit. Ecology requires that the base of the UIC is a minimum of 15 feet above the seasonal high groundwater level.

Construction of UIC's is similar to water well construction. The small diameter of the wells reduces impacts and risks associated with other methods requiring larger diameter excavations. Installation of the UIC's can be completed with a sonic or air rotary drill rig commonly used in water well construction, and UIC construction would likely be around 1 day for each UIC.

Based on the analysis by RMGW, whose report is provided in Appendix B, a single UIC with a 12-inch diameter and installed to a depth of 60 feet will support a flow rate of 70 gpm, which includes a factor of safety of 2. The wells will extend into and be terminated within the glacial advance outwash. The 60-foot depth limitation is to maintain a 15-foot separation from the estimated seasonal high groundwater level. If multiple UIC's are necessary to provide the required capacity, they should be spaced approximately 50-feet apart without impacting adjacent UIC's.

Construction impacts to install the UIC's would be similar to those resulting from the geotechnical investigation, as similar equipment would be used to install the UIC's. We anticipate a 60-foot deep drilled drain could be installed in one day. Equipment used to install UIC's consists of a truck mounted drill rig using hollow stem auger or roto-sonic drilling methods. These types of borings use augers or drill casing to maintain hole stability, such that caving or sloughing of the boring sidewalls is not a concern.

5.1.2 Drilled Drains

Drilled drains consist of large diameter borings completed within the receptor unit and backfilled with a vertical carrier pipe surrounded with porous filter media. Drilled drains can be installed as a separate infiltration method or can be combined and installed within an infiltration trench to provide additional infiltration area.

Drilled drains are typically 2 to 3-feet in diameter, which can be completed with a bucket type or auger drill rig. Larger diameter drains are feasible but require equipment like that used to construct drilled shafts. A well screen or perforated pipe is used to vertically route flow to the bottom of the drain and the annular space between the pipe and the sidewall is backfilled with porous filter media. Hole stability and changing ground conditions may require the use of temporary steel casing to complete the hole to the required depth and to support construction of the drain.

The larger diameter of the driller drains, as compared to UIC's will support a higher flow rate. It is estimated that a 3-foot diameter drilled drain will have a flow rate of 100 gpm, which includes a safety factor of 2. Four drilled drains, spaced approximately 90-feet apart, are expected to support the design flow rate of 172 gpm. The depth of the wells will be approximately 60-feet deep to maintain a vertical separation of 15-feet from groundwater. With a length of 60- feet the drains will extend and be terminated within the glacial outwash deposits.

Construction impacts could be similar to installation of UIC's although risks associated with hole stability and changing ground conditions are higher. A drilled drain, 2-feet in diameter, installed to a depth of 60 feet, will likely be completed in 2-days. Equipment used to install drilled drains typically includes a truck mounted bucket auger drill rig or track mounted auger drills. Hole stability issues, if encountered, will require additional equipment and temporary casing increasing impacts, project duration, and costs. Sloughing and caving conditions should be minimal due to the shallow depth to the dense glacial till. A short section of temporary casing may be required at the ground surface to address loose fill soils.

5.1.3 Proprietary Dry Well System – MaxWell Plus

Dry wells consist of a large diameter excavation in which an open bottom structure, such as a maintenance hole, is installed into the receptor material and is used to infiltrate stormwater. They are similar to drilled drains, but typically have a large 6 to 10-foot diameter, and depth of installation is limited to the excavator reach and hole stability.

Proprietary dry well systems, such as the Maxwell Plus system from Torrent Resources, are feasible and their benefit over a standard dry well or drilled drain is that they are engineered to provide water quality treatment at each unit above the section that provides infiltration. They are available locally from Oldcastle.

The Maxwell system requires a 6-foot diameter drilled shaft installed to a depth of approximately 18-feet, to accommodate the water quality treatment section. Below the 6-foot diameter shaft, a 4-foot diameter shaft extends into the receptor unit (glacial advance outwash and transition bed deposits) to the design depth of the well. The 4-foot diameter shaft is perforated to infiltrate water to the surrounding formation. Like the UIC's and drilled drains the system would be installed to a depth of 60-feet to maximize infiltration capacity and to maintain a 15-foot separation from the seasonal high groundwater level. The 4-foot diameter, 40-foot long, infiltration shaft of the Maxwell Plus dry well system, will support a flow rate of 130 gpm, which includes a safety factor of 2. If multiple units are installed, they should be spaced approximately 100 feet apart to avoid impacting adjacent wells.

The Maxwell system requires a larger construction footprint in comparison to UIC's and drilled drains and is like that required to install a utility maintenance hole structure. Drilled shaft construction the 4-foot diameter infiltration shaft below the structure carries significant risks associated with hole stability and changing ground conditions. The use of temporary casing would likely be required to maintain hole stability and to prepare the base for inserting the upper water quality chamber section.

5.2 INFILTRATION IMPACTS

Infiltration of stormwater can potentially impact adjacent properties, through unwanted seepage, which can impact below grade structures and reduce slope stability. All the proposed infiltration methods identified above will infiltrate stormwater below an approximate elevation of 310 in the western portion of the site and approximate elevation 290 at the southeaster portion of the site, assuming the glacial till is 22 feet thick. Potential impacts of the infiltration measures identified above are expected to be similar and discussed below.

5.2.1 Seepage

Flow from the UIC's or other alternative infiltration systems will result in both horizontal and vertical flow away from the facility below elevations varying from 290 to 310 and will be below the glacial till material. Infiltration will be into the glacial advance outwash material and will eventually flow into groundwater at an approximate elevation between 232 and 252, depending on location.

The property generally slopes down to the east. Lateral flow is not expected to impact downslope properties based on existing topography, depth to groundwater, the distance from the infiltration source.

5.2.2 Slope Stability

We reviewed the topography of the areas identified on Figure 5, within 400 feet of the proposed infiltration location. The project area slopes down to the southeast with grades typically less than 10%. Slopes on adjacent private properties are similar, and the overall slope from the site down to the toe of the slope along the Eastside trail Corridor is approximately 15%. No landslides are mapped within four hundred feet of proposed infiltration areas.

The proposed infiltration will not impact slope stability in the area.

5.2.3 Separation

Groundwater is present at a depth of approximately 76 feet below the project area and a minimum separation of 15-feet is required below the base of UIC's and drilled drains. Infiltration system installation should be limited to an installation of depth of approximately 62 feet BGS, which will satisfy groundwater separation requirements.

5.2.4 Soil Suitability for Treatment

The water quality treatment capability of the glacial advance outwash, in which infiltration is proposed, was evaluated through the CEC and organic matter content testing; the results of which are provided in Appendix C. A CEC of at least 5 meq per 100 grams and a minimum organic content of 1.0 percent are required for the soil to be considered to provide water quality treatment.

Samples of the glacial advance outwash encountered in EB2-3 from a depth of 21 to 37 feet, meet the CEC requirement of a minimum of 5 meq per 100 grams, however, only the sample collected at a depth of 21 feet has an organic content greater than 1.0, samples below 21-feet BGS, all have organic contents less than 1%. Soils below a depth of 21 feet do not meet the DOE criteria for organic matter content to be considered capable of providing water quality treatment.

The glacial advance outwash and transition bed deposits are considered to have “Low” treatment capacity in accordance with Table I-4.2 (WWSMM, 2019). This classification is based on:

- The deposit extends a minimum of 15 feet below the base of the well and seasonal high groundwater.
- The soil is typically described as sand as indicated on the summary logs,
- Grain size analyses provided in Appendix A indicate the material average grains size is between 0.125 to 4 mm, and
- CEC value is typically less than 2meq per 100 grams, and organic matter contents are less than 0.5%, as indicated in Table 2 and Appendix C.

5.2.5 Groundwater Mounding

A groundwater mounding analysis has yet to be completed for the project pending decision on the type of and locations of the system(s). A mounding analysis for similar soil conditions in Kirkland, located in the Rose Hill neighborhood indicated groundwater mounding above the seasonal high groundwater level will be approximately 12-feet. The analysis predicted the mound would dissipate as distance from the facility increases, such that at approximately 1,100 feet the predicted groundwater levels would rise approximately 6-inches.

Development or significant increase in flow from existing groundwater seeps, if present, on the slopes to the east of the site, are not predicted based on ground surface elevations in the area.

5.3 CRITICAL AREAS: GEOLOGICALLY HAZARDOUS AREAS

5.3.1 Steep Slopes

Slope areas that KZC Chapter 5 – DEFINITIONS, identifies as “Geological Hazardous Areas”, include: High Landslide Hazardous Areas and Moderate Landslide Hazardous Areas. These areas are defined as:

High Landslide Hazard Area:

1. *Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or that are underlain or covered by mass wastage debris of that epoch; or*
2. *Areas with both of the following characteristics:*
 - a. *Slopes steeper than 15 percent that intersect geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment, and*
 - b. *Springs; or*
3. *Areas potentially unstable because of rapid stream incision, stream bank erosion, or undercutting by wave action; or*
4. *Any area with a slope of 40 percent or steeper over a height of at least 10-feet.*
5. *For areas meeting the criteria of subsections (1) through (4) of this definition, the high landslide area also includes the area within a horizontal distance “H” equal to either the height of the slope or 50 feet, whichever is greater.*

Moderate Landslide Hazard Area:

Are sloped areas with slopes between 15 percent and 40 percent that do not meet the definition of High Landslide Hazard Area.

Slope areas identified by the City of Kirkland that may potentially meet the City of Kirkland definition of “Geologically Hazardous Areas” are shown on Figure 5. These areas are identified by the City GIS software that calculates the slope percentage based on limited contour information and does not account for vertical elevation drop across the area or the size of the area.

In accordance with the requirements of KZC Chapter 85 - Critical Areas: Geologically Hazardous Areas, we reviewed the City of Kirkland online geologic hazard maps of the area to identify areas that meet the KZC definition of “High” or “Moderate Landslide Hazard Areas”. Based on our review, the project site does not contain any sloped areas that meet the City of Kirkland Zoning Code Chapter 5 definition of High Landslide Hazard Areas” or “Moderate Landslide Hazard Areas”. The areas identified as “Moderate Landslide Hazard Areas” by the City of Kirkland online GIS map of the area, as shown on Figure 5, do not have sufficient vertical relief and do not have the geologic conditions that meet the KZC definition.

5.4 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

Construction impacts along with operation, and long-term maintenance requirements will vary depending on the infiltration system selected. Construction impacts, potential risk, and general cost information are summarized in Table 3.

TABLE 3 . Infiltration Method Considerations

Infiltration Method	Size	Estimated Long-Term Flow Rate¹	Construction Impacts	Risks	Maintenance Regards to Maintaining Infiltration	Comparable Cost
UIC	8-inch Dia. Well Screen 12-inch Dia. Hole 45-feet deep	70	Smallest footprint - Equipment like that used in our investigation	Low	Easy maintenance able to clean out and rehab Easy to add another well	\$10K to \$15k per well
Drilled Drains	3-feet Dia. 45-feet deep 6-inch Well Screen	100	Small footprint slightly larger than UIC's	Medium	Easy maintenance able to clean out and rehab	\$20K to \$25k per well
Proprietary Dry Well MaxWell Plus	6-feet Dia. to 18-feet BGS, 4-feet Dia. to 45-feet BGS	130	Large due to size of excavation required	Med- High	Infiltration - Nothing if treatment performs as expected. Treatment portion yearly to clean out floatable debris and replace oil absorbent pillows.	\$\$\$

1. Estimated Flow Rate is based on the results of in-situ testing and a factor of safety of 2 has been applied to the field measured rates.

6.0 LIMITATIONS

We have prepared this report for use by King County Housing Authority and members of their design and construction team for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites. Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during excavation and construction, re-evaluation will be necessary.

The site development plans, and design details were preliminary at the time this report was prepared. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in this report for consideration in design.

Within the limitations of scope, schedule, and budget, our services were executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty, express or implied, should be understood.

◆ ◆ ◆

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

NV5

Kevin J. Lamb, P.E.
Principal Engineer



05/15/2023

REFERENCES

DOE, 2019, *Stormwater Management Manual for Western Washington*, July 2019, Washington State Department of Ecology Water Quality Program, Publication number 19-10-021, P. 1108.

IT/GIS, Topographic Map: City of Kirkland
<https://maps.kirklandwa.gov/Html5Viewer/>

Minard, James P., 1983, Geologic Map of the Kirkland Quadrangle, Washington, Miscellaneous Field Studies, Map MF-1543, United States Geological Survey.

Washington State Department of Natural Resources, 2020. *Washington Geologic Information Portal*. Accessed from website <https://geologyportal.dnr.wa.gov>. Website dated 2020.



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KCHA-38-04

MAY 2023

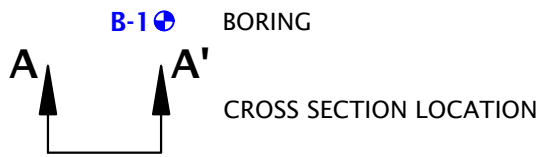
VICINITY MAP

KIRKLAND HEIGHTS IMPROVEMENTS
KIRKLAND, WA

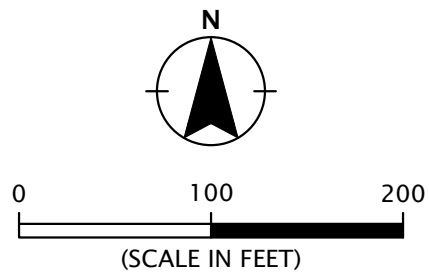
FIGURE 1




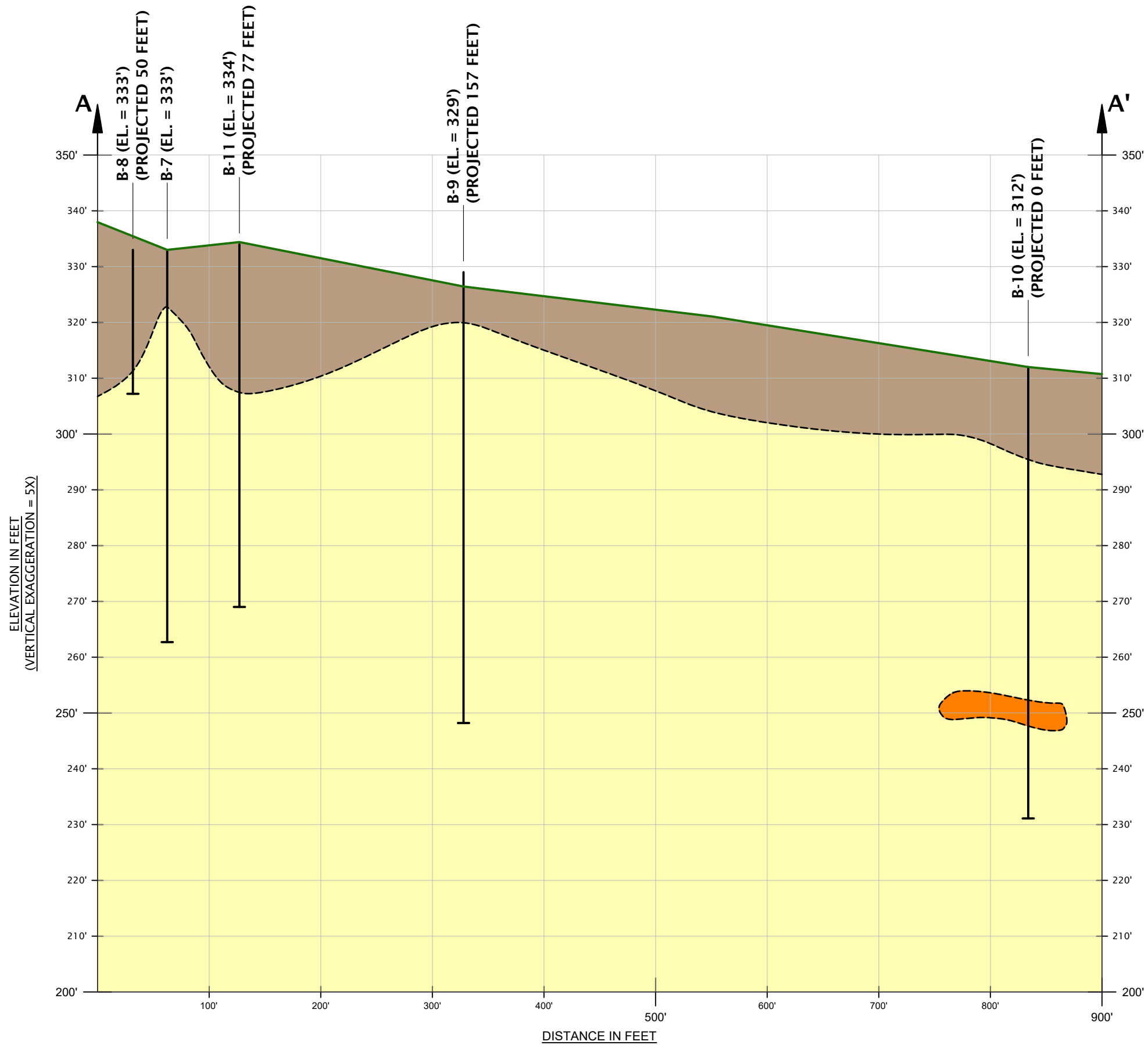
LEGEND:



SITE PLAN BASED ON AERIAL PHOTOGRAPH DATED
JUNE 20, 2021, OBTAINED FROM GOOGLE EARTH PRO.

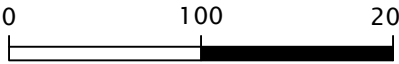


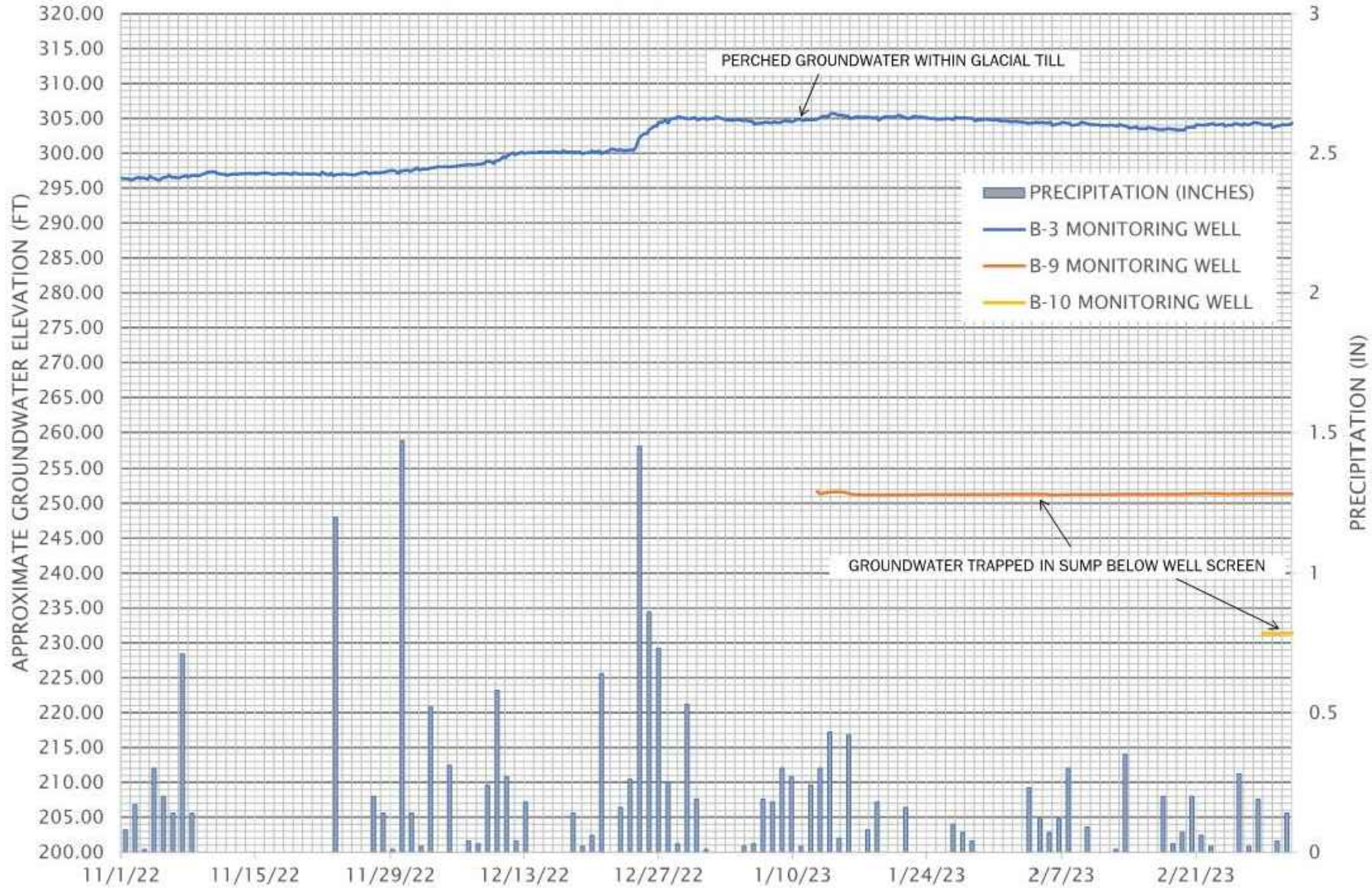
	KCHA-38-04	SITE PLAN
	MAY 2023	KIRKLAND HEIGHTS IMPROVEMENTS KIRKLAND, WA
FIGURE 2		

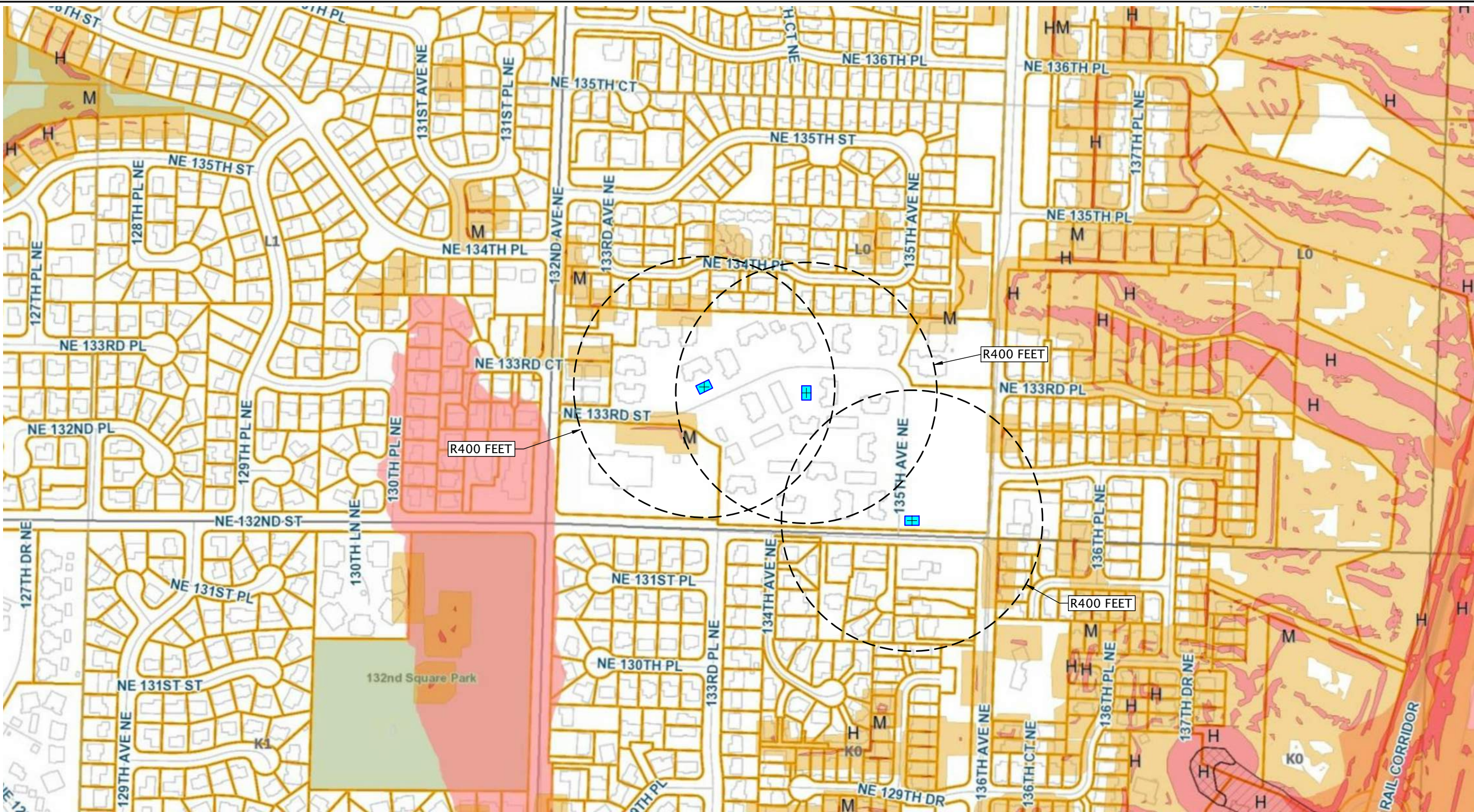


- LEGEND:**
- EXISTING TOPOGRAPHY
 - BORING
 - INTERPRETED CONTACT
 - GLACIAL TILL
 - ADVANCE OUTWASH
 - CLAY LENSE

VERTICAL EXAGGERATION = 5X





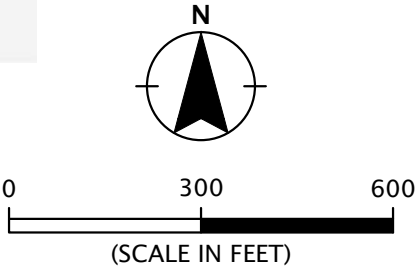


LEGEND:

--- 400-FOOT-RADIUS INFILTRATION ZONE OF INFLUENCE BOUNDARY

■ PROPOSED INFILTRATION AREA

Landslide	City Limits	Lakes
■ Deposit Areas	□ Grid	■ Parks
■ Head Scarps	□ QQ Grid	■ Schools
■ High Susceptibility	■ Regional Rail Corridor	
■ Moderate Susceptibility	■ Cross Kirkland Corridor	
Liquefaction Potential	■ Streets	
■ High	■ Parcels	
■ Medium or Mixed	■ Buildings	



SITE PLAN BASED ON IMAGE OF SHEET PRODUCED BY CITY OF KIRKLAND GIS (2023).

APPENDIX A

FIELD EXPLORATIONS

GENERAL

Subsurface conditions at the site were explored by drilling five borings (B-7 through B-11) to depths between 25.8 to 80.8 feet BGS between March 8 to March 11, 2022. Boring B-7 through B-10 were drilled by Borettec¹ of Auburn, Washington with a track-mounted drill rig. Holt Drilling Services completed boring B-11 using roto sonic drilling methods. The exploration logs are presented in this appendix. The locations of the explorations were determined based on existing conditions, field measurements and hand-held GPS. This information should be considered accurate to the degree implied by the methods used.

LABORATORY TESTING

SOIL SAMPLING

A member of our staff observed the explorations. We collected representative samples of the various soil encountered in the explorations for geotechnical laboratory testing. Borings B-7 through B-10 were sampled using the SPT at intervals of approximately 5-feet. Boring B-11 was completed using roto sonic drilling methods that used a 20-foot long core barrel to drill and sample. The soil was extracted from the core barrel in 2.5-foot increments and placed in plastic bags for logging and laboratory sample collection. Disturbed soil samples were collected from the samplers at 2.5-foot intervals.

SOIL CLASSIFICATION










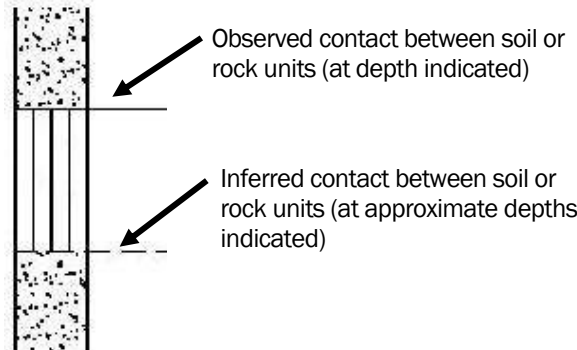

The soil samples were classified in accordance with the “Exploration Key” (Table A-1) and “Soil Classification System” (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soil or their characteristics change, although the change could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.


MOISTURE CONTENT

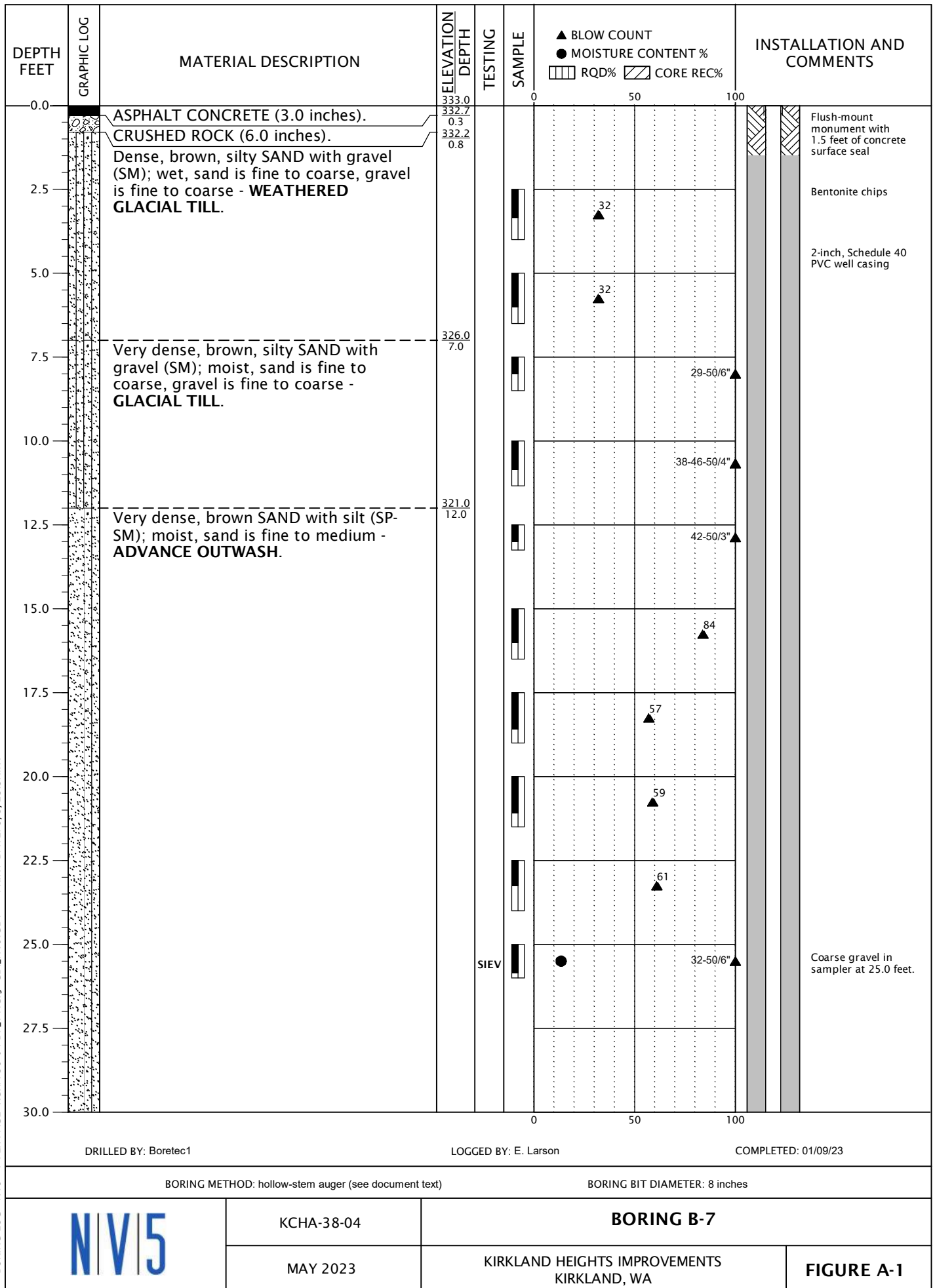
Moisture content determinations were completed on select soil samples in general accordance with ASTM D2216. The moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

GRAIN-SIZE ANALYSIS

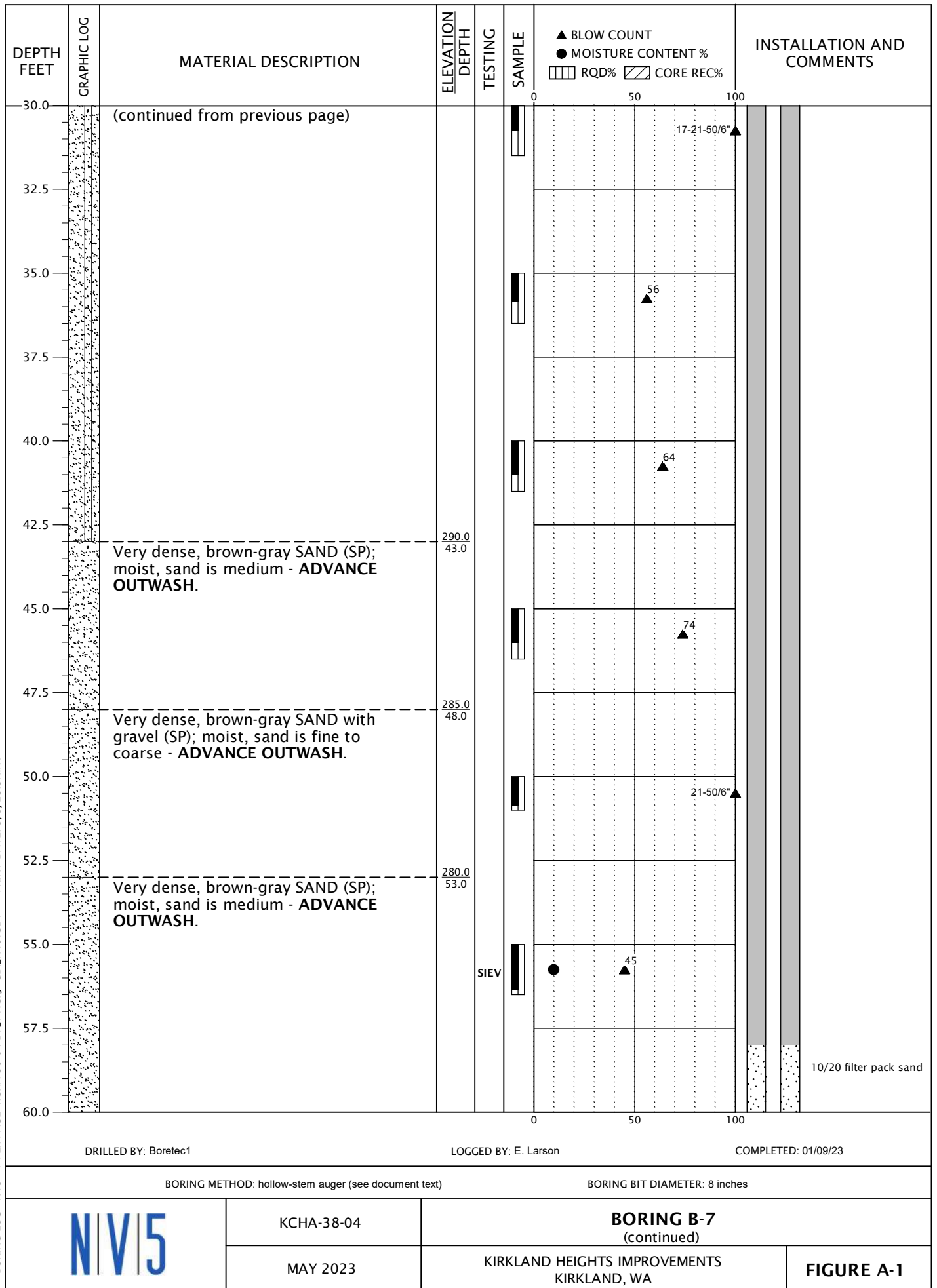
We completed grain-size analyses on select soil samples in order to determine the distribution of soil particle sizes. The testing was completed in general accordance with ASTM C117/ASTM C136 or ASTM D1140 (P200). The test results are presented in this appendix.

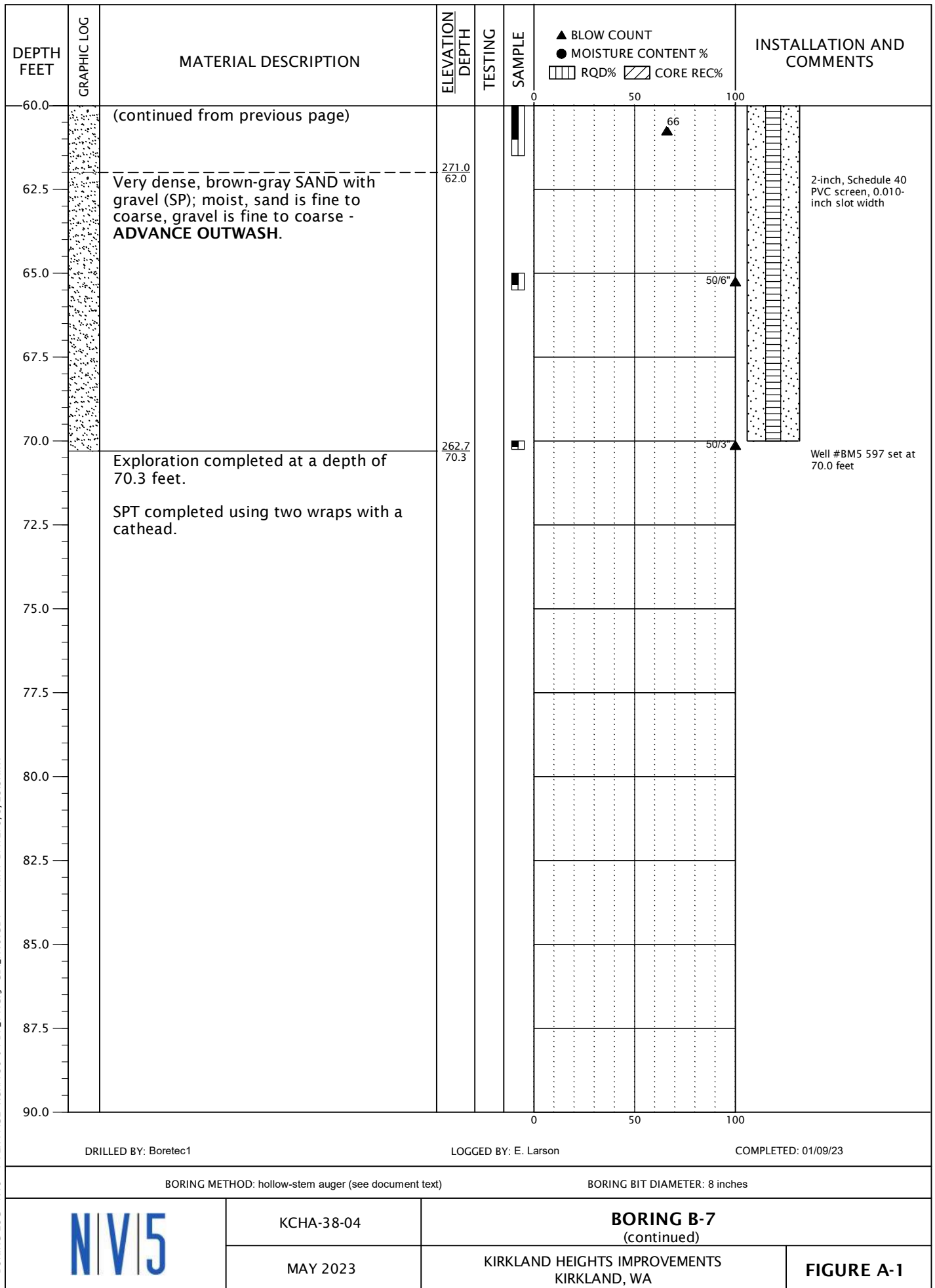
SYMBOL		SAMPLING DESCRIPTION	
	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test (SPT) with recovery		
	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery		
	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery		
	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery		
	Location of sample collected using 3-inch-outside diameter California split-spoon sampler and 140-pound hammer with recovery		
	Location of grab sample		
	Rock coring interval		
	Water level during drilling		
	Water level taken on date shown		
<div><div>Graphic Log of Soil and Rock Types</div></div>			
GEOTECHNICAL TESTING EXPLANATIONS			
ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density		
DS	Direct Shear	RES	Resilient Modulus
HYD	Hydrometer Gradation	SIEV	Sieve Gradation
MC	Moisture Content	TOR	Torvane
MD	Moisture-Density Relationship	UC	Unconfined Compressive Strength
NP	Non-Plastic	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal
ENVIRONMENTAL TESTING EXPLANATIONS			
CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen
		EXPLORATION KEY	
		TABLE A-1	

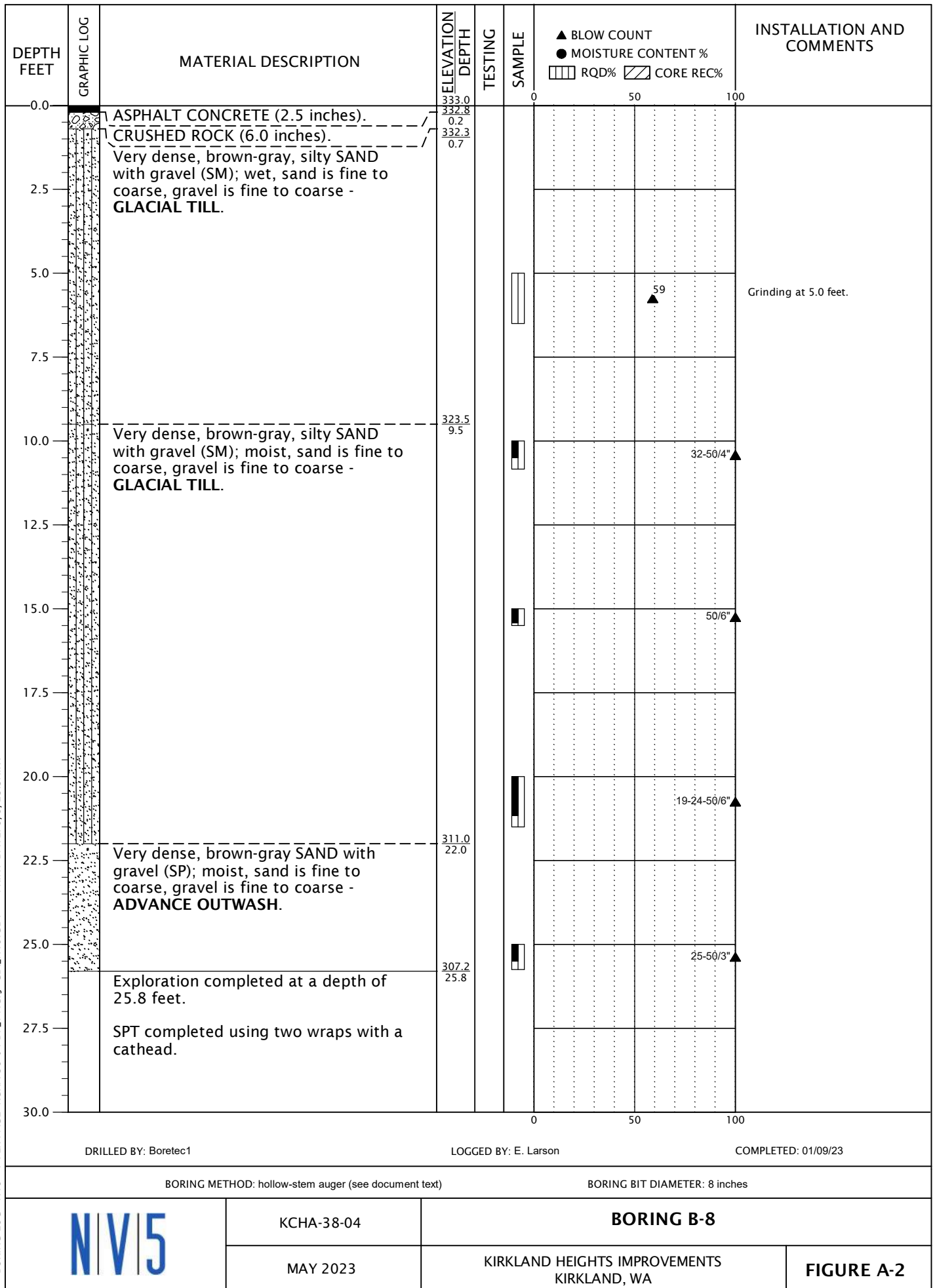
RELATIVE DENSITY - COARSE-GRAINED SOIL							
Relative Density	Standard Penetration Test (SPT) Resistance		Dames & Moore Sampler (140-pound hammer)		Dames & Moore Sampler (300-pound hammer)		
Very loose	0 – 4		0 – 11		0 – 4		
Loose	4 – 10		11 – 26		4 – 10		
Medium dense	10 – 30		26 – 74		10 – 30		
Dense	30 – 50		74 – 120		30 – 47		
Very dense	More than 50		More than 120		More than 47		
CONSISTENCY - FINE-GRAINED SOIL							
Consistency	Standard Penetration Test (SPT) Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)			
Very soft	Less than 2	Less than 3	Less than 2	Less than 0.25			
Soft	2 – 4	3 – 6	2 – 5	0.25 – 0.50			
Medium stiff	4 – 8	6 – 12	5 – 9	0.50 – 1.0			
Stiff	8 – 15	12 – 25	9 – 19	1.0 – 2.0			
Very stiff	15 – 30	25 – 65	19 – 31	2.0 – 4.0			
Hard	More than 30	More than 65	More than 31	More than 4.0			
PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME			
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL			
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt			
			GW-GC or GP-GC	GRAVEL with clay			
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL			
			GC	clayey GRAVEL			
			GC-GM	silty, clayey GRAVEL			
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND			
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt			
			SW-SC or SP-SC	SAND with clay			
		SAND WITH FINES (> 12% fines)	SM	silty SAND			
			SC	clayey SAND			
			SC-SM	silty, clayey SAND			
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)		Liquid limit less than 50	ML	SILT			
	CL		CLAY				
	CL-ML		silty CLAY				
	OL		ORGANIC SILT or ORGANIC CLAY				
	Liquid limit 50 or greater	MH	SILT				
		CH	CLAY				
		OH	ORGANIC SILT or ORGANIC CLAY				
HIGHLY ORGANIC SOIL			PT	PEAT			
MOISTURE CLASSIFICATION		ADDITIONAL CONSTITUENTS					
Term	Field Test	Secondary granular components or other materials such as organics, man-made debris, etc.					
		Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil			
dry	very low moisture, dry to touch	< 5	trace	trace	< 5	trace	trace
moist	damp, without visible moisture	5 – 12	minor	with	5 – 15	minor	minor
wet	visible free water, usually saturated	> 12	some	silty/clayey	15 – 30	with	with
					> 30	sandy/gravelly	Indicate %
		SOIL CLASSIFICATION SYSTEM					TABLE A-2



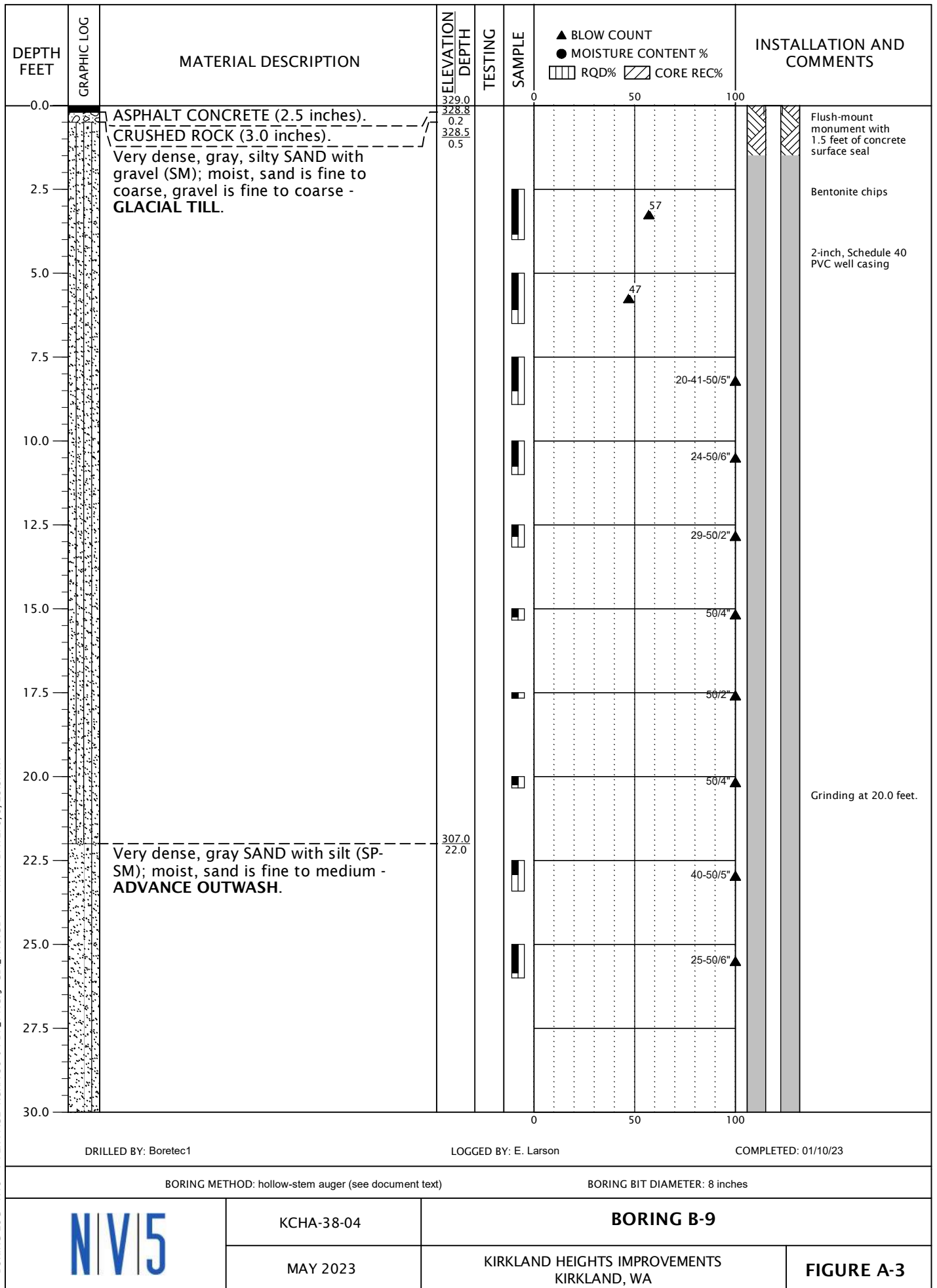
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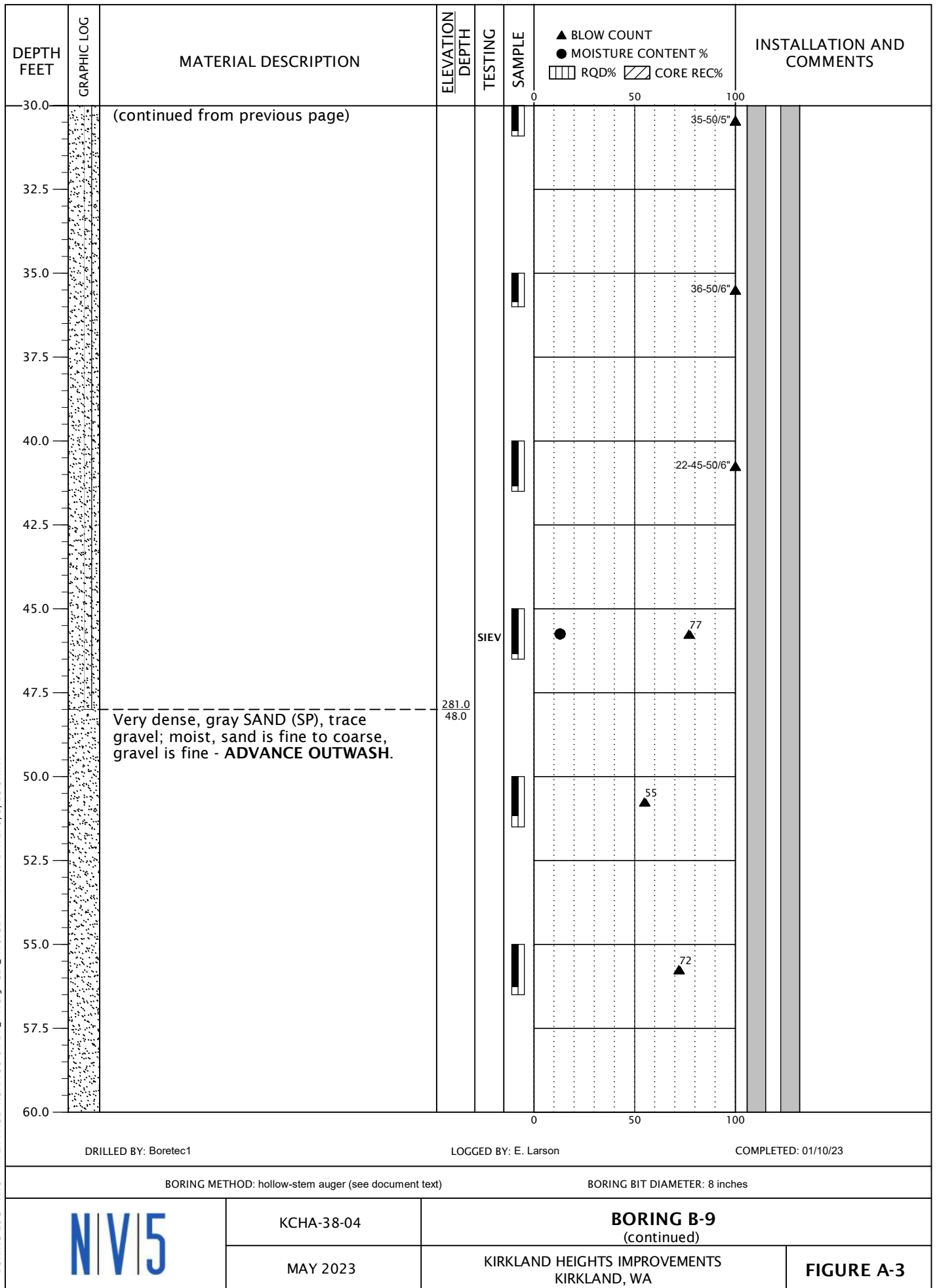




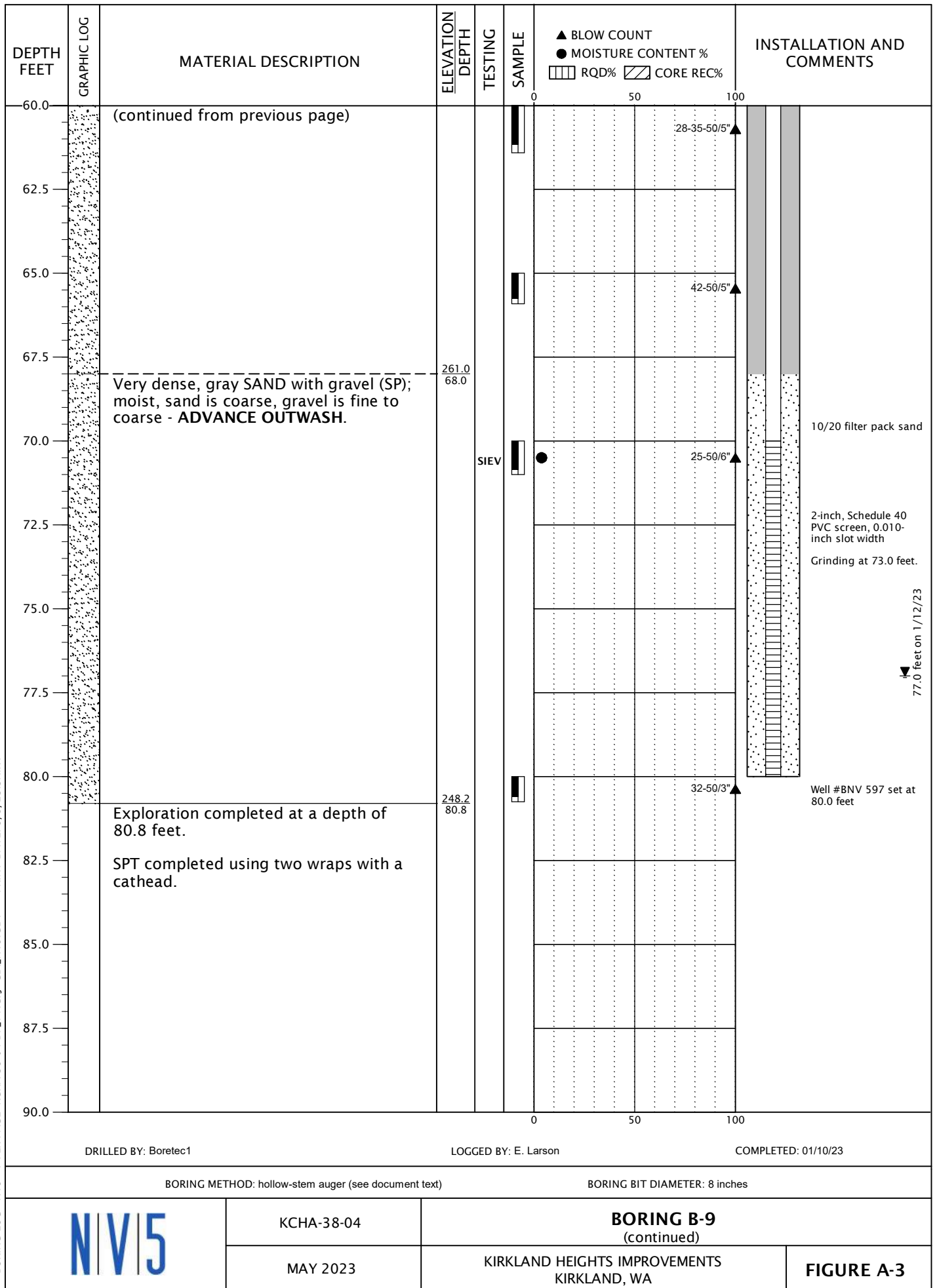
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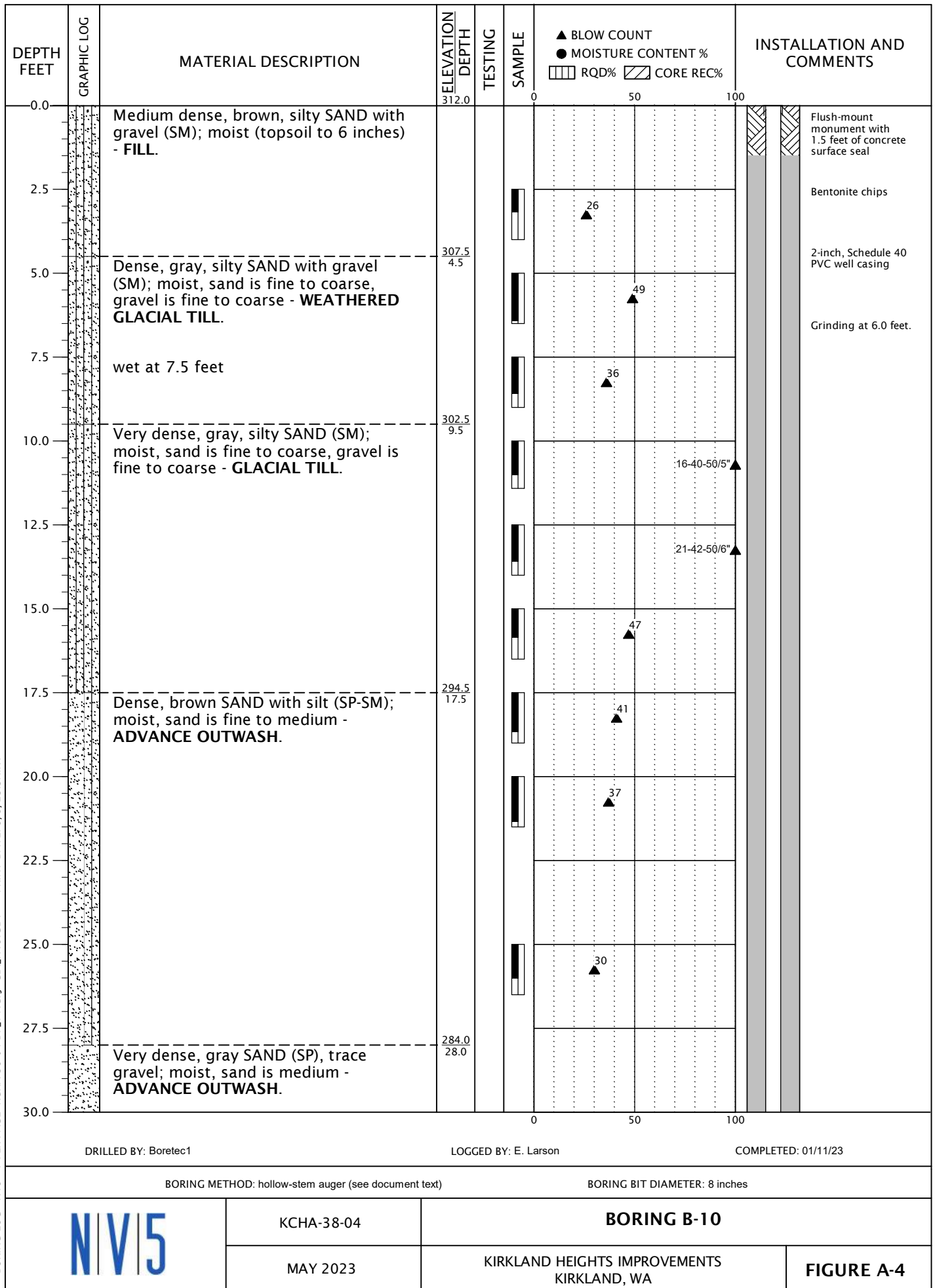


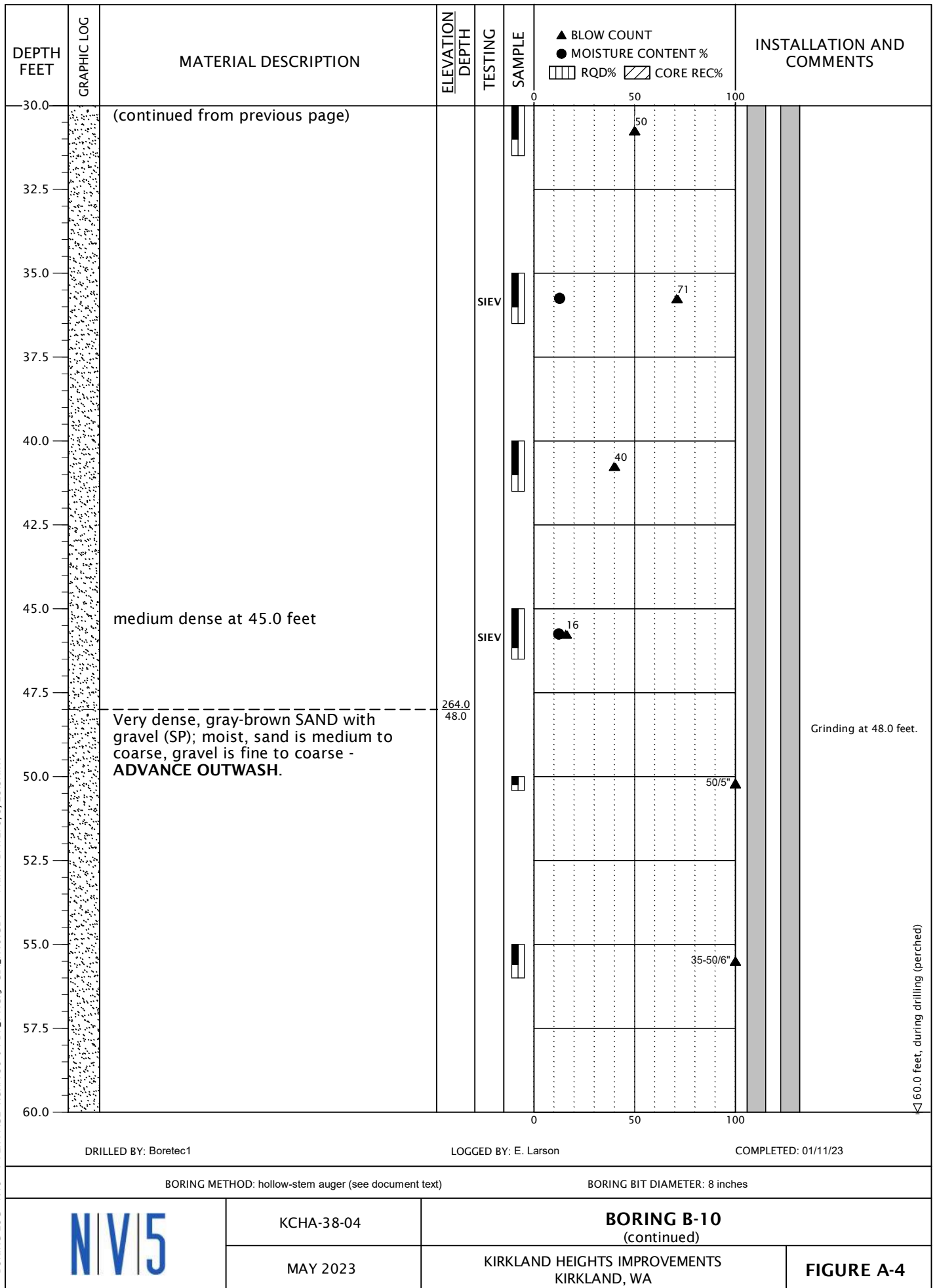
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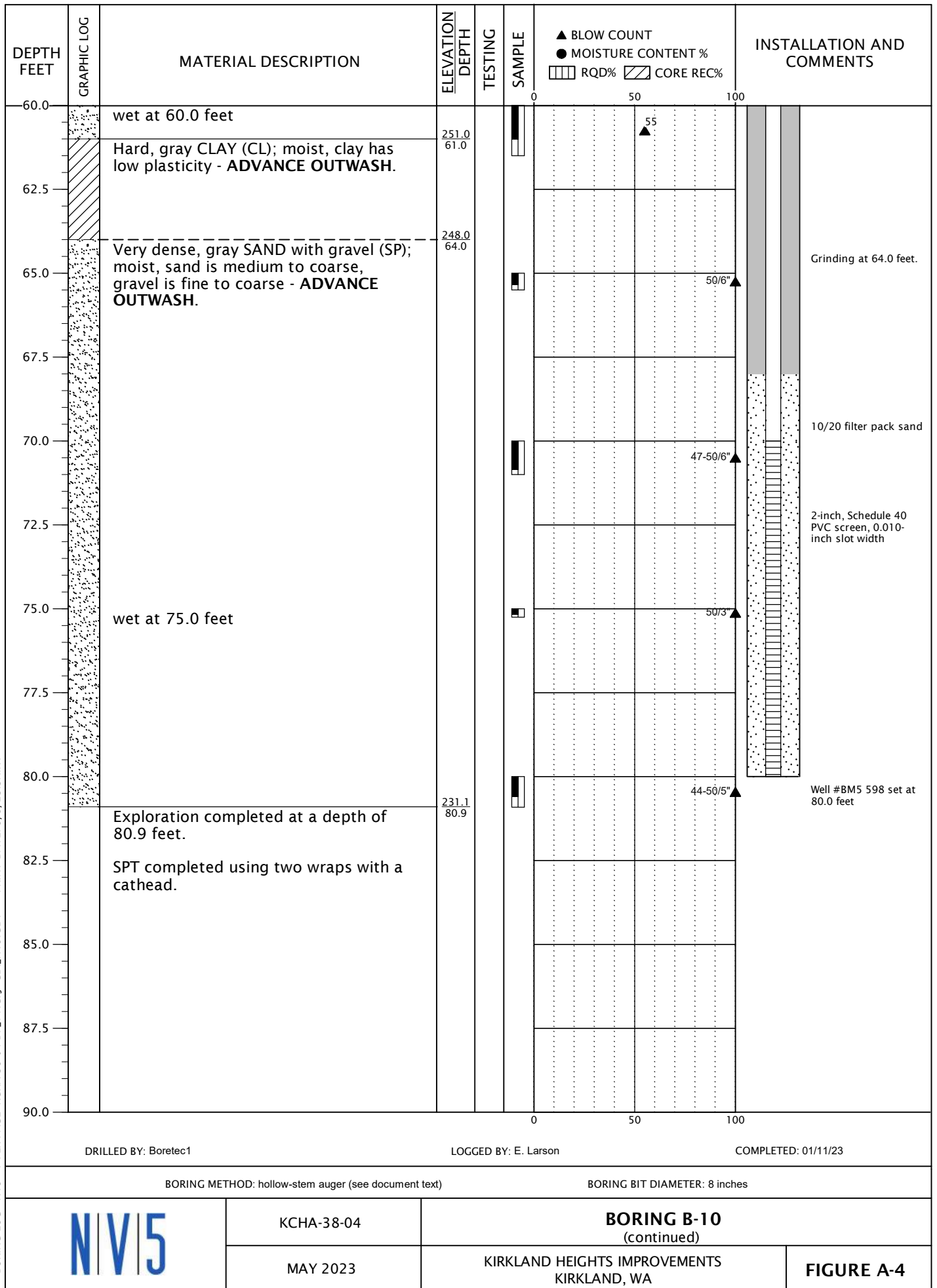




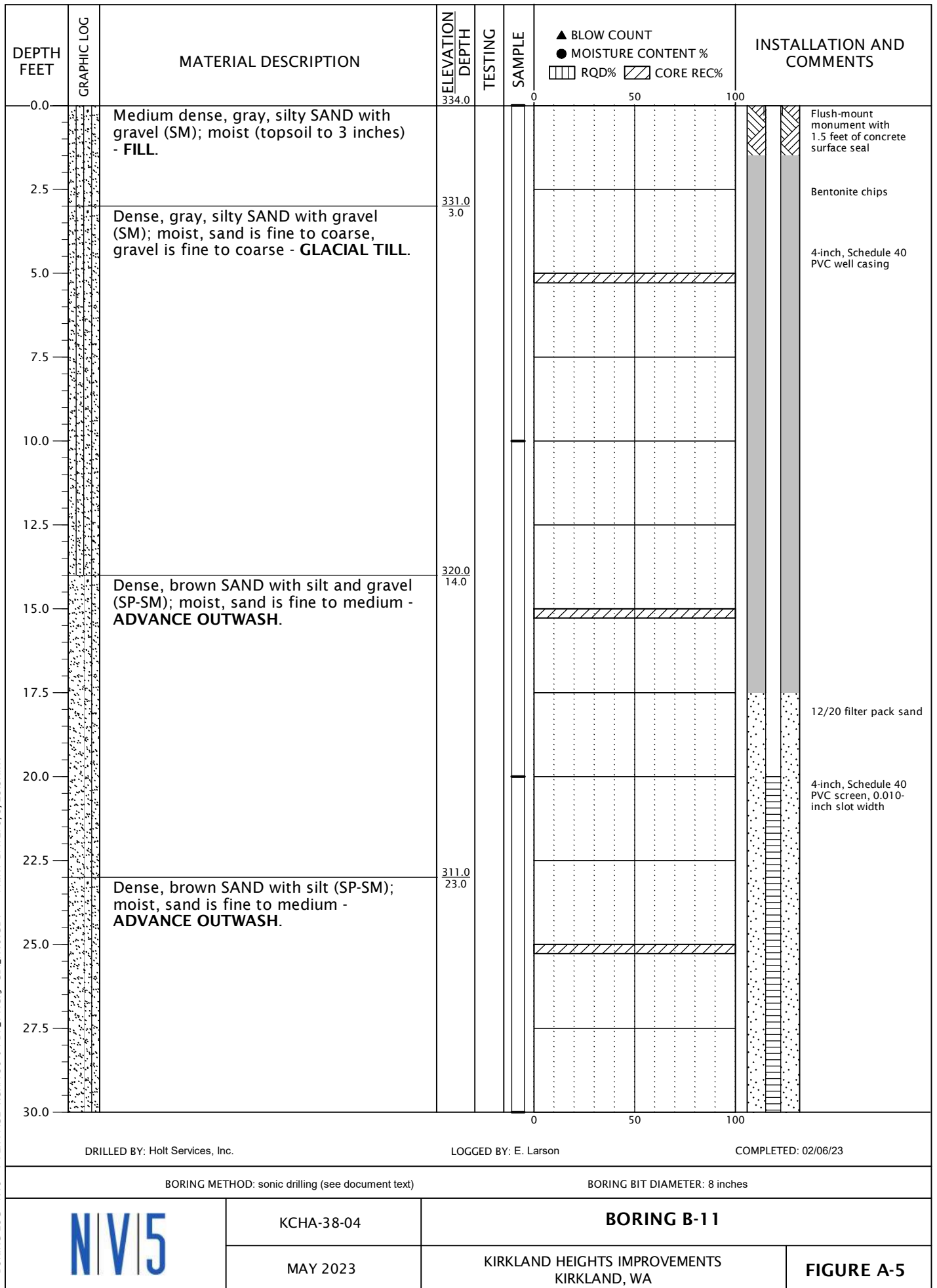


60.0 feet, during drilling (perched)


BORING LOG - NV5 - 1 PER PAGE KCHA-38-04-B7_11.GPJ GDL NV5.CDT PRINT DATE: 5/9/23:SN:KT



BORING LOG - NV5 - 1 PER PAGE KCHA-38-04-B7_1.1.GPJ GD_LNV5.CDT PRINT DATE: 5/9/23:SN:KT

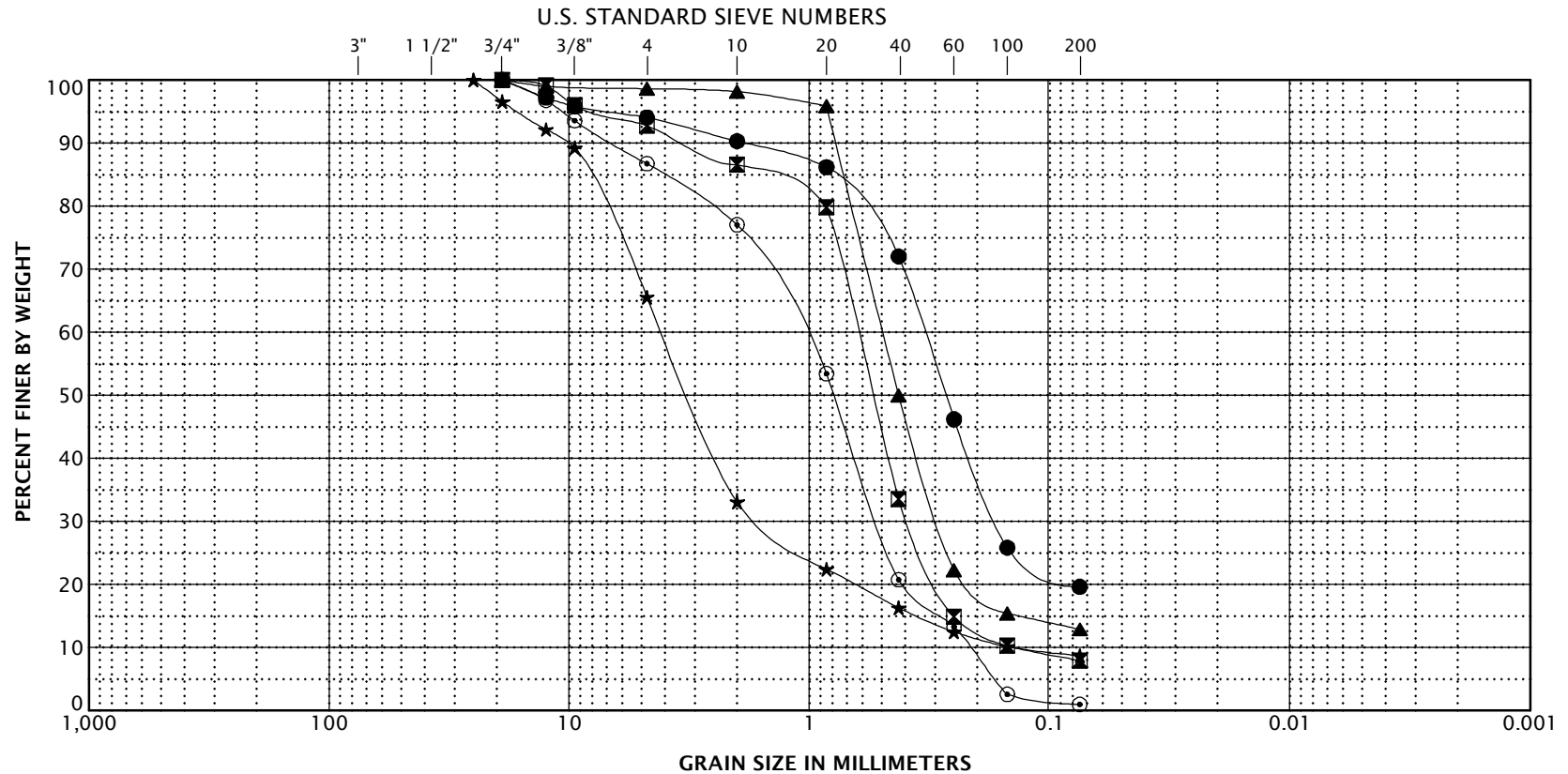


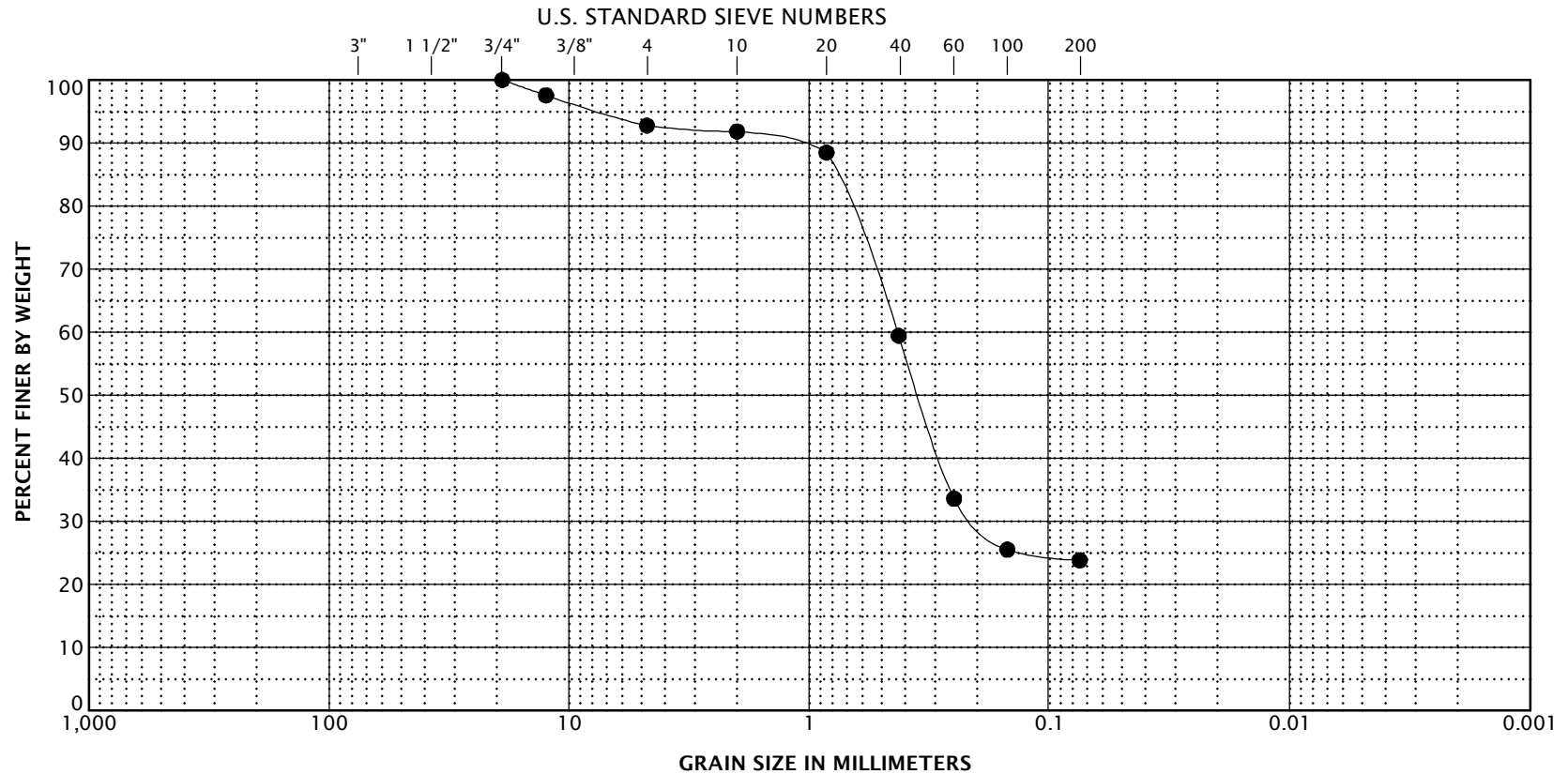
BORING LOG - NV5 - 1 PER PAGE KCHA-38-04-B7_11.GPJ GDL NV5.CDT PRINT DATE: 5/9/23:SN:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % □ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
30.0		(continued from previous page)			0	50100	
32.5							
35.0							
37.5							
38.0		Dense, brown, silty SAND (SM); moist, sand is fine - ADVANCE OUTWASH.	296.0				
39.0		Dense, brown SAND with silt (SP-SM), trace gravel; moist, sand is fine to medium - ADVANCE OUTWASH.	295.0				
40.0							
42.5							
45.0							
47.5							
49.0		Dense, gray SAND with gravel (SP); moist, sand is fine to coarse, gravel is fine - ADVANCE OUTWASH.	285.0				
50.0							
52.0		Dense, brown-gray SAND (SP), trace gravel; moist, sand is medium to coarse - ADVANCE OUTWASH.	282.0				
52.5							
55.0							
57.5							
59.0		Dense, brown-gray SAND with gravel (SP); moist, sand is medium to coarse.	275.0				
60.0					0	50100	
DRILLED BY: Holt Services, Inc.		LOGGED BY: E. Larson		COMPLETED: 02/06/23			
BORING METHOD: sonic drilling (see document text)				BORING BIT DIAMETER: 8 inches			
		KCHA-38-04	BORING B-11 (continued)				
		MAY 2023	KIRKLAND HEIGHTS IMPROVEMENTS KIRKLAND, WA		FIGURE A-5		

BORING LOG - NV5 - 1 PER PAGE KCHA-38-04-B7_11.GPJ GDLNV5.CDT PRINT DATE: 5/9/23:SN:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % RQD% CORE REC%	INSTALLATION AND COMMENTS	
60.0		gravel is fine to coarse - ADVANCE OUTWASH.	269.0 65.0			050100		Well #BPL 499 set at 60.0 feet
62.5								
65.0		Exploration completed at a depth of 65.0 feet.						
67.5								
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								
85.0								
87.5								
90.0						050100		
DRILLED BY: Holt Services, Inc. LOGGED BY: E. Larson COMPLETED: 02/06/23								
BORING METHOD: sonic drilling (see document text)						BORING BIT DIAMETER: 8 inches		
		KCHA-38-04	BORING B-11 (continued)					
		MAY 2023	KIRKLAND HEIGHTS IMPROVEMENTS KIRKLAND, WA				FIGURE A-5	





BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	D60	D50	D30	D10	D5	GRAVEL (PERCENT)	SAND (PERCENT)	SILT (PERCENT)	CLAY (PERCENT)
●	B-10	45.0	12	0.43	0.35	0.20			7	69	24	




KCHA-38-04

MAY 2023

GRAIN-SIZE TEST RESULTS
(continued)

KIRKLAND HEIGHTS IMPROVEMENTS
KIRKLAND, WA

FIGURE A-6

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-7	25.0	308.0	13		6	74	20			
B-7	55.0	278.0	10		7	85	8			
B-9	45.0	284.0	13		1	86	13			
B-9	70.0	259.0	4		34	57	9			
B-10	35.0	277.0	13		13	86	1			
B-10	45.0	267.0	12		7	69	24			
			KCHA-38-04		SUMMARY OF LABORATORY DATA					
			MARCH 2023		KIRKLAND HEIGHTS IMPROVEMENTS KIRKLAND, WA				FIGURE A-11	

APPENDIX B

RICHARD MARTIN GROUNDWATER, LLC

HYDROGEOLOGIC REPORT



Richard Martin Groundwater LLC

May 12, 2023

Kevin Lamb
NV5
19201 120th Avenue SE, Suite 201
Bothell, WA 98011

**RE: King County Housing Authority Infiltration Testing and Evaluation, Kirkland Heights
Redevelopment Project, Kirkland, Washington**

This letter presents our evaluation of infiltration capacity and recommendations for potential deep infiltration facility design for the King County Housing Authority's (KCHA) Kirkland Heights project in Kirkland, Washington. It is our understanding that KCHA is redeveloping an existing multi-family housing site, which includes renovation of existing buildings, construction of a new Community Center and two new apartment buildings, enhancements to parking lots and sidewalks, and construction of new entry driveway. The project has proposed the potential use of infiltration to manage stormwater runoff. Initially, the project proposed the use of infiltration trenches, but based on observed subsurface conditions UIC wells and drilled drains are being considered as an alternative to the trenches.

Initial explorations were performed by NV5 (2022) as part of the preliminary geotechnical and shallow infiltration feasibility. As part of the current scope to support design, NV5 performed an additional 5 deeper explorations. The recent explorations included installation of three monitoring wells and a 4-inch test well. We performed infiltration testing on the 4-inch test well, with the testing procedures, data collected during testing, and evaluation of the infiltration feasibility and capacity described in this letter.

Our current scope of services includes:

- Review existing soil and groundwater information;
- Perform infiltration testing on the new 4-inch test well;
- Evaluate infiltration feasibility and capacity; and,
- Prepare a brief letter report summarizing the results of the testing and evaluation.

This letter report will be included as an appendix to the Geotechnical Report prepared by NV5.

SUBSURFACE CONDITIONS

Site soil and groundwater conditions are described in the main section of the Geotechnical Report.

With the exception of the undeveloped eastern portion of the property (east of 135th Avenue NE) the soils generally consists of varying thickness of Glacial Till underlain by Advance Outwash. The Glacial Till ranges in thickness from approximately 11 to 22 feet, and consists of dense to very dense silty sand with

gravel. The Advance Outwash extends to greater than 80 feet below ground surface (bgs), and generally consists of fine to medium sand with silt to trace silt. A clay layer was observed in boring B-10 approximately 61 to 64 feet bgs.

Soils below the eastern portion of property include near surface fill extending 1 to 8 feet bgs, and consisting of silty sand with gravel. In several explorations the fill was underlain by Recessional Outwash consisting of silty sand with gravel and ranging in thickness from approximately 3 to 13 feet. Underlying the fill and Recessional Outwash was Glacial Till.

Groundwater was encountered during drilling of borings B-9 and B-10 at a depth of approximately 77 and 75 feet bgs, respectively. Groundwater was not observed in the other borings during drilling. Monitoring wells were installed borings B-7, B-9, and B-10, while a 4-inch test well was installed in B-11. Groundwater has been observed in monitoring wells B-9 and B-10 following drilling. The location of the wells is shown in the Geotechnical Report.

The unsaturated Advance Outwash is the target soil for deep infiltration. The following table summarizes the subsurface conditions:

Boring	Depth (feet)	Depth to Groundwater (feet)	Thickness of Fill and Till (feet)	Thickness of Unsaturated Zone (feet)
B-7	70	NO*	12	>58
B-8	26	NO*	22	>4
B-9	80	77	22	55
B-10	81	75	17	58
B-11	65	NO*	13	>52

* NO = not observed during drilling

** Thickness includes silt transitional beds

INFILTRATION TESTING PROCEDURES

Infiltration testing was performed in the 4-inch B-11 test well to estimate potential infiltration rates and capacity for proposed deep infiltration UIC facilities. There are currently no testing requirements for deep infiltration facilities in the City of Kirkland stormwater regulations or in the King County Surface Drainage Manual; however testing requirements for deep infiltration facilities are provided in Appendix D of the Seattle Stormwater Manual. The infiltration testing was performed in general accordance with the Seattle Stormwater Manual testing requirements, and based on our experience with deep infiltration testing.

A description of the test well installation is provided in the main text of the Geotechnical Report and on the boring logs. The well consists of 40 feet of 4-inch PVC screen (10-slot). A filter pack consisting of 12-20 silica sand was installed in the annulus between the well screen and the 8-inch borehole to approximately 5 feet below and 2.5 feet above the screened portion of the well. Above the filter pack, the well was completed with a bentonite chip seal and a steel monument installed flush with the ground surface.

Deep infiltration testing is similar to shallow infiltration whereby potable water is added to the test well at a measured rate and the water level in the well is observed. The test is performed until “steady-state” conditions are achieved or a minimum of 4 hours. For the purposes of these tests, “steady-state” was assumed when the change in water level and rate is less than 10 percent for a minimum of 1 hour. At the end of testing, the water is turned off and rate of the falling water level is observed.

Because of the volume of water needed for testing, a fire hydrant permit was obtained for a hydrant located approximately 30 feet east of the test well. The local water supply is operated by the Woodinville Water District. Per the permit requirements, a hydrant meter and backflow assembly were obtained from the Woodinville Water District. Water was conveyed to the test wells using fire hose.

A 10-foot, 2-inch, PVC drop pipe was used to deliver the water into the test well to reduce turbulent flow and air entrapment. The water flow rate was measured and controlled using Flomec digital flow meter and a ball valve to control the flow. The water level in the well was measured using a pressure transducer/datalogger system, with the water level recorded on 1-minute intervals. The target water level for the test was approximately 30 feet above the bottom of the screen.

B-11 Infiltration Test

The infiltration testing for test well B-11 was performed on March 8, 2023. The testing was initiated at 10:07, with an initial flow rate of approximately 50 gallons per minute (gpm) to the test well based on our observation of soil conditions during drilling. The water level rise was relatively slow and the flow rate was slowly increased over the next half hour to steady-state rate of approximately 90 gpm. After 1.5 hours, the flow rate was decreased as the rate of water level rise increased. The flow rate was adjusted to maintain the water level at approximately 28 feet, with the flow rate dropping from approximately 90 gpm to 48 gpm by the end of the test. The total test time was approximately 5.5 hours.

After turning the water off, the water level dropped rapidly with the transducer indicating the water level was approximately 5 feet above the bottom of screen within approximately 25 minutes.

Figure 1 shows the water level data downloaded from the datalogger along with the flow rate. The data show that the test did not achieve steady-state conditions with a slow rise in water level during the final two hours of test. Several factors may have contributed to continued slow rise. As noted above, a clay layer was observed in boring B-10 approximately 61 to 64 feet bgs. Although not observed during drilling of the test well to a depth of 65 feet bgs, if this layer was present below the test well infiltrating water could have perched on the layer resulting in a decrease in infiltration capacity as the water mounded on the layer. As alternative explanation includes fine layering that was not readily observed in the soil samples resulting in primary horizontal flow. The lack of steady state conditions at the end of the test is considered as part of the correction factor described below.

INFILTRATION CAPACITY ANALYSIS

An infiltration capacity analysis was performed using an analytical groundwater spreadsheet model based on the borehole permeameter (BP) approach, which provides a relatively simple, closed-form, analytical method for estimating a bulk hydraulic conductivity. This approach, sometimes referred to as the Constant Head Well Permeameter approach, was originally developed by Glover (Zanger 1953) and further refined by others, such as Elrick et al. (1998) and Reynolds (2007). The BP approach assumes steady state infiltration from an open borehole into a homogeneous isotropic soil and is based on the concept that the water infiltrating from the borehole flows radially and downward in response to pressure and gravity gradients.

The analysis estimates the bulk hydraulic conductivity based on the borehole/well geometry, the steady-state flow rate to the borehole, the hydraulic head rise, and assumed characteristics of unsaturated flow in specific soil types. The term bulk hydraulic conductivity is used because the testing procedures and analysis approach does not differentiate between the horizontal and vertical components of flow, and the result represents a combination of the two components of the hydraulic conductivity value. Additional information on the specific equations and assumptions are provided in Kindred and Reynolds (2020).

The results of the BP approach provide an estimation of the bulk soil hydraulic conductivity of soil being tested, which can then be used to estimate the potential infiltration capacity of an infiltration facility. For the test performed in test well B-11, the resulting bulk hydraulic conductivity was estimated to be between 5 and 8 feet per day.

The resulting bulk hydraulic conductivity and BP approach can then be used to extrapolate infiltration capacities for different well/drain/trench geometries, as described below.

INFILTRATION CAPACITY AND DESIGN RECOMMENDATIONS

This section provides recommendations for infiltration capacity for deep infiltration facilities and general recommendations for the design, construction, operation, and maintenance of drilled drains and UIC wells.

The Washington State Department of Ecology requires a vertical separation between the base of a UIC facility and the seasonal high groundwater table. Ecology has released the 2019 Stormwater Management Manual for Western Washington that increases the vertical separation from 5-feet to 15-feet, effective October 1, 2019 in cases where a low permeability soil layer (e.g. Glacial Till) is at ground surface and limits the natural downward movement of water. Because of the Till cap in the project area, a 15-foot vertical separation between the bottom of the UIC wells and the seasonal high groundwater level is required.

Design Infiltration Capacity

The bulk hydraulic conductivity values estimated from the test data is converted to a design hydraulic conductivity by applying correction factors including a testing factor based on the test data (0.6), a factor to account for soil variability (0.9), a clogging factor (0.9), and a facility geometry factor (0.9), resulting in a total correction factor of 0.4. The design hydraulic conductivity is then used to estimate infiltration capacity rates for several different diameter drains/wells. The infiltration capacity rates assume that the drains/wells are within the Advance Outwash and the water level is allowed to rise to within 5 feet of ground surface.

We recommend the following design infiltration capacity rates for the drain/well systems:

Type of Facility	Facility Diameter (feet)	Infiltration Capacity (gpm)
UIC Well	1	70
Drilled Drain	3	100

Actual infiltration capacity will depend on the subsurface conditions encountered during construction, construction methods, and operation and maintenance of the facilities.

Infiltration Facility Performance Monitoring and Operation

Careful consideration to surface works should be taken to reduce long-term impacts to the performance of the infiltration facilities. In addition to reducing the potential for sediment to flow into the facilities, surface filtration and treatment systems should be designed to reduce the potential for bacterial growth. In particular, systems should be designed to reduce the amount of organic carbon, nitrites/nitrates, and phosphorous that reaches the infiltration facilities.

Periodic monitoring of water levels in the facilities should be performed to confirm that the water is readily draining into the adjacent soil. Observation of water in the facilities after a period of dry conditions may be an indication that the capacity and performance is degrading.

If reduced capacity or performance of the facilities is observed, maintenance may be required. If sedimentation in the drains or wells is observed, redevelopment may be required to remove sediment and may include surging and pumping, and/or jetting to remove sediment.

ADDITIONAL RECOMMENDATIONS

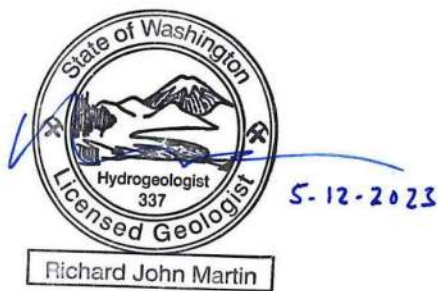
We recommend that RMGW be contracted during drilling and installation activities of infiltration facilities to observe soil and groundwater conditions and provide additional recommendations as needed.

LIMITATIONS

This letter was prepared for the exclusive use of NV5, Station 10 Engineering, and the King County Housing Authority. The opinions and conclusions provided in this report are based on review of site soil and groundwater data from project explorations, the results of infiltration testing in project test wells, and our experience with infiltration facility design in King County. This report was prepared in accordance with generally accepted professional principles and practice in this area at this time. No other warranty, either express or implied, is made.

If you have any questions or comments, please contact me at 206-979-1530 or at Richard.martin.gw@gmail.com.

Sincerely,



Richard J. Martin, L.H.G.
Richard Martin Groundwater LLC

Enclosures:

Figure 1 – Test Well B-11 Test Data

REFERENCES

Archer, N.A, M. Bonell, A.M. MacDonald, N. Coles, 2014, A Constant Head Well Permeameter Formula Comparison: Its Significance in the Estimation of Field-Saturated Hydraulic Conductivity in Heterogeneous Shallow Soils, *Hydrology Research*, 45(6), pg. 788-805.

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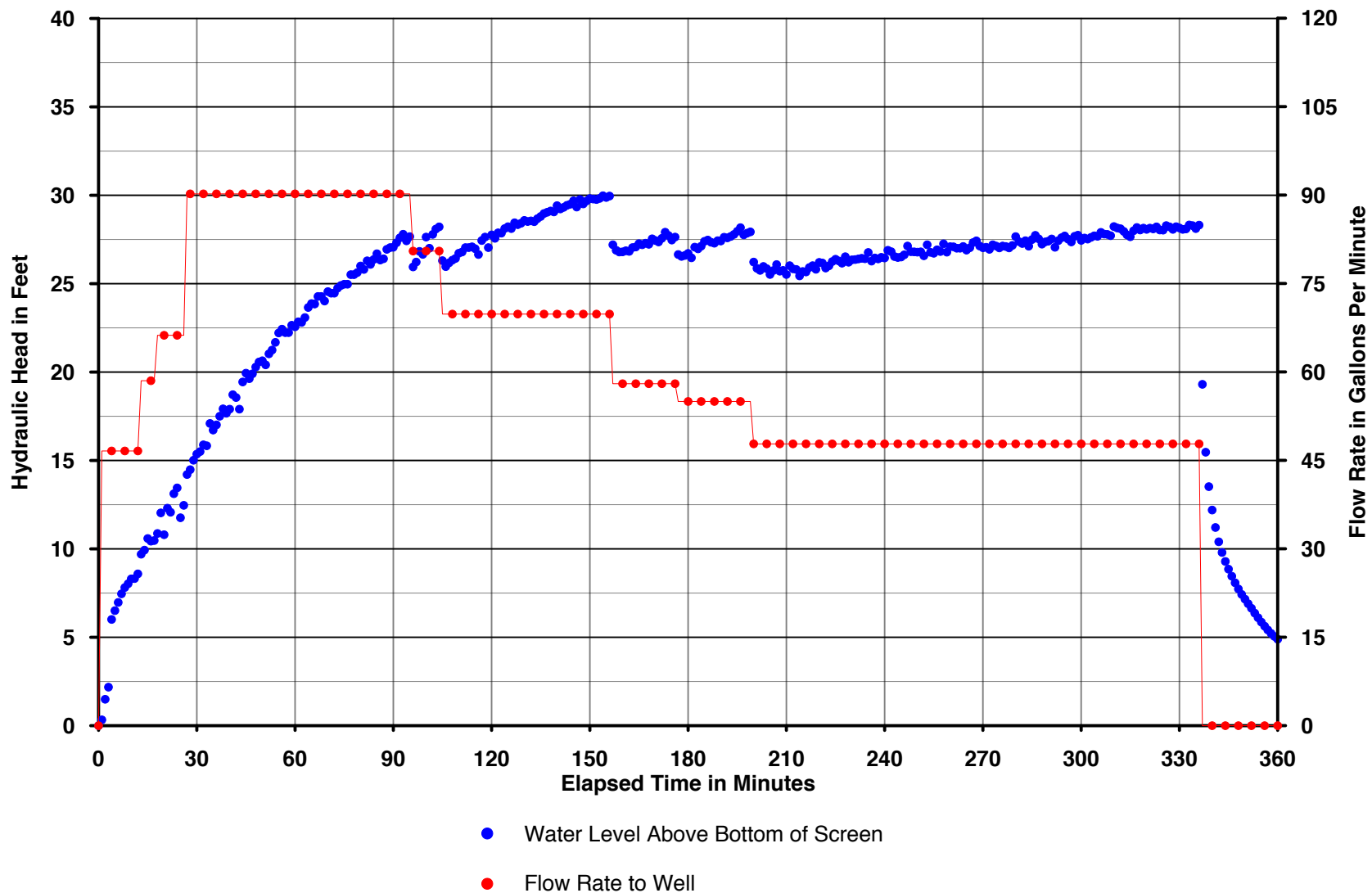
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Kirkland Heights Well B-11 Infiltration Testing Data



Richard Martin
Groundwater LLC

Kirkland Heights - King County Housing Authority
Kirkland, Washington

March 15, 2023

Figure 1

Figure 1

APPENDIX C

AMTEST

CEC AND ORGANIC MATTER TESTING

AmTest Chain of Custody Record

 13600 NE 126th PL, Suite C, Kirkland, WA 98034

Ph (425) 885-1664 Fx (425) 820-0245

www.amtestlab.com

 Chain of Custody No. **5000**

Client Name & Address: NV5 19201 120th Ave NE Suite 201 Bothell, WA 98011				Invoice To: NV5 19201 120th Ave NE Suite 201 Bothell, WA 98011													
Contact Person: Eric Larson				Invoice Contact: Eric Larson													
Phone No: 5094818465				PO Number: KCHA-38-04													
Fax No:				Invoice Ph/Fax: 5094818465													
E-mail: eric.larson@nv5.com				Invoice E-mail: eric.larson@nv5.com													
Report Delivery: (Choose all that apply) Mail / Fax / <u>Email</u> / Posted Online				Data posted to online account: YES <u>NO</u> Web Login ID:													
Special Instructions:																	
Requested TAT: (Rush must be pre-approved by lab) Standard <u>RUSH</u> (5 Day / 3 Day / 48 HR / 24 HR)						Temperature upon Receipt: 7.8°C											
Project Name: Kirkland Heights Apartments		Date Sampled	Time Sampled	Matrix	No. of containers	Analysis Requested											
Project Number: KCHA-38-04																	
AmTest ID	Client ID. (35 characters max)																
3776	B-7 38-36.5		1000	Soil	1	X	X										
3777	B-7 45-46.5		1000	Soil	1	X	X										
3778	B-9 35-36.5		1000	Soil	1	X	X										
3779	B-9 40-41.5		1000	Soil	1	X	X										
3780	B-10 30-31.5		1000	Soil	1	X	X										
3781	B-10 40-41.5		1000	Soil	1	X	X										
Collected/Relinquished By:	Date	Time	Received By:			Date	Time										
	3/2/23	0930	KL			3/2/23	9:30										
Relinquished By:	Date	Time	Received By:			Date	Time										
Relinquished By:	Date	Time	Received By:			Date	Time										

COMMENTS:

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com



**Professional
Analytical
Services**

ANALYSIS REPORT

NV5
19201 120TH AVE NE
BOTHELL, WA 98011
Attention: ERIC LARSON
Project Name: KIRKLAND HEIGHTS APARTMENTS
Project #: KCHA-38-04
PO Number: KCHA-38-04
All results reported on an as received basis.

Date Received: 03/02/23
Date Reported: 3/28/23

AMTEST Identification Number 23-A003776
Client Identification B-7 35-30.5
Sampling Date , 10:00

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	3.7	meq/100g		0.5	SW-846 9081	CM	03/24/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.4	%			SM 2540G	HV	03/16/23

NV5
Project Name: KIRKLAND HEIGHTS APARTMENTS
AmTest ID: 23-A003777

AMTEST Identification Number **23-A003777**
Client Identification **B-7 45-40.5**
Sampling Date **, 10:00**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	2.1	meq/100g		0.5	SW-846 9081	CM	03/24/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.1	%			SM 2540G	HV	03/16/23

AMTEST Identification Number **23-A003778**
Client Identification **B-9 35-36.5**
Sampling Date **, 10:00**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	3.0	meq/100g		0.5	SW-846 9081	CM	03/24/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.3	%			SM 2540G	HV	03/16/23

NV5
Project Name: KIRKLAND HEIGHTS APARTMENTS
AmTest ID: 23-A003779

AMTEST Identification Number **23-A003779**
Client Identification **B-9 40-41.5**
Sampling Date **, 10:00**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	3.2	meq/100g		0.5	SW-846 9081	CM	03/24/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.1	%			SM 2540G	HV	03/16/23

AMTEST Identification Number **23-A003780**
Client Identification **B-10 30-31.5**
Sampling Date **, 10:00**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	3.1	meq/100g		0.5	SW-846 9081	CM	03/24/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.3	%			SM 2540G	HV	03/16/23

NV5
Project Name: KIRKLAND HEIGHTS APARTMENTS
AmTest ID: 23-A003781

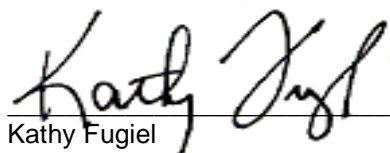
AMTEST Identification Number **23-A003781**
Client Identification **B-10 40-41.5**
Sampling Date **, 10:00**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	3.0	meq/100g		0.5	SW-846 9081	CM	03/24/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.3	%			SM 2540G	HV	03/16/23



Kathy Fugiel
President

Am Test Inc.
13600 NE 126th PL
Suite C
Kirkland, WA, 98034
(425) 885-1664
www.amtestlab.com



**Professional
Analytical
Services**

QC Summary for sample numbers: 23-A003776 to 23-A003781

DUPLICATES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	DUP VALUE	RPD
23-A004548	Cation Exchange Capacity	meq/100g	8.7	10.	14.
23-A004548	Organic Matter	%	6.3	6.2	1.6

STANDARD REFERENCE MATERIALS

ANALYTE	UNITS	TRUE VALUE	MEASURED VALUE	RECOVERY
Cation Exchange Capacity	meq/100g	4.0	4.0	100. %

BLANKS

ANALYTE	UNITS	RESULT
Cation Exchange Capacity	meq/100g	< 0.2

SECTION 26 00 00

ELECTRICAL GENERAL CONDITIONS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 01 - General Requirements for all work in Divisions 26, 27 and 28.

1.2 SUMMARY

- A. Design Intent: The project includes Electrical, Fire Alarm and Low Voltage systems for the commercial scope of a campus wide substantial renovation to an existing low-income apartment complex consisting of 24 existing apartment buildings owned by King County Housing Authority, located in Kirkland WA. The Commercial scope includes a new 4,000 square foot Community Building and the new site lighting infrastructure.
 - 1. The Division 26 Electrical scope is full design per these specs and the supporting project contract documents.
 - 2. The Electrical Contractor shall perform all Division 26 electrical permitting with the City of Kirkland.
 - 3. All Fire Alarm and Low Voltage Systems are Design-Build; Contract Documents (drawings and specifications) are meant to provide information (scope, performance requirements, preliminary quantities and locations, etc) for Bidding by Design-Build Contractors only. All final quantities and locations of equipment and devices shall be coordinated with the Fire Marshal/ Local AHJ (as applicable), Architect and Owner prior to the start of construction.
 - 4. The Electrical Contractor and their subcontractor(s) shall design, submit for plan review, permit, provide and install complete a fully operational and coordinated design for the Fire Alarm and Low Voltage systems that meet all requirements of the Owner, local AHJ and as per the Project Contract Documents.
 - 5. The Fire Alarm and Low Voltage Design-Build Contractor(s) shall be a subcontractor(s) to the Electrical Contractor.
 - 6. Fire Alarm Systems (Fire Alarm):
 - a. In addition to administrative requirements of this Specification Section, see Specification Sections 28 46 00 and the Contract Drawings for system performance requirements for bidding by the Fire Alarm Design-Build Contractor.
 - 7. Low Voltage Systems:
 - a. See Specification Section 27 00 00 for a complete list of Low Voltage Systems to be included in the Project.
- B. In addition to administrative requirements of this Specification Section, see all Division 27 and 28 Specification Sections and the Contract Drawings for system performance requirements for bidding by the Low Voltage Design-Build Contractor.

- C. Sustainability Goals: The Project is pursuing Evergreen Sustainable Development Standards (ESDS) Certification. The Electrical Contractor shall coordinate with the Architect and General Contractor to ensure compliance with the Prerequisites and intended Credits for the project. See Division 01 Specification and subsequent Division 26, 27 and 28 Specifications for additional information and requirements.
- D. Photovoltaic System (PV):
 - 1. There will be a Design-Built photovoltaic system on the roof sized to meet the requirements of Section C406.5 of the Washington Energy Code. Final size to be confirmed by Architect and PV Contractor.
 - 2. The Design-Build Contractor shall design, submit for plan review, permit, provide and install a complete and fully operational PV system per the requirements of Fire Marshal, local AHJ and as per the Project Contract Documents.
 - 3. For Bidding purposes, assume the system shall be comprised of 320W solar modules by Silfab Solar (formerly iTek Energy) or pre-approved equal (manufacturer must comply with Made in Washington requirements for solar modules) with microinverters (one per solar module) and a ballasted racking system.
 - 4. The Electrical Contractor shall hire a Photovoltaic Design-Build Subcontractor with at least eight (8) years' experience designing, Permitting, and installing PV systems of similar size and type.
- E. The Electrical Contractor shall provide all labor, materials, equipment and devices, supports, etc necessary for satisfactory installation of electrical work ready to operate in strict accordance with Code requirements and the Project specifications and drawings.
- F. Related Sections: All Division 01, 26, 27 and 28 Specification Sections included in the Contract Documents.
- G. Commissioning Activities and Submittals: The Project shall be commissioned per Energy Code and ESDS requirements. The Contractor shall coordinate with the General Contractor, Architect and Commissioning Agent and provide support for the complete commissioning process as required. See Divisions 01, 26, 27 and 28 for additional information.

1.3 CODES AND STANDARDS:

- A. All work shall meet or exceed the requirements of the current versions of all applicable Federal, State, and Local Codes and Standards including but not limited to:
 - 1. National Electrical Code (NEC) with Local Amendments / Washington Cities Electrical Code.
 - 2. Washington State Residential Energy Code with Local Amendments.
 - 3. ESDS Requirements.
 - 4. International Fire Code (IFC) with Local Amendments.
 - 5. International Building Code (IBC) with Local Amendments.
 - 6. International Mechanical Code (IMC) with Local Amendments.
 - 7. Uniform Plumbing Code (UPC) with Local Amendments.
 - 8. The Americans with Disabilities Act (ADA).

9. Illuminating Engineering Society of North America (IESNA) Standards and Recommended Practices.
10. National Fire Protection Association (NFPA) Standards and Recommended Practices.
11. Applicable Standards of the following organizations (see subsequent Division 26, 27 and 28 sections for additional information):
 - a. American National Standards Institute (ANSI).
 - b. American Society for Testing Materials (ASTM).
 - c. Building Industry Consulting Services International (BICSI).
 - d. Federal Acquisition Regulation (FAR).
 - e. Institute of Electrical and Electronics Engineers (IEEE).
 - f. National Electrical Manufacturer's Association (NEMA).
 - g. U.S. Department of Housing and Urban Development (HUD).
 - h. Underwriter's Laboratories (UL) standards.
12. Utility Service Provider Requirements.

1.4 SUSTAINABLE DESIGN REQUIREMENTS:

- A. Comply with Project Requirements to achieve Evergreen Sustainable Development Standards (ESDS) V4.0 Certification.
- B. Comply with Construction Management Plan. Refer to Division 01.
- C. ESDS-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC per referenced standards in Rating System Requirements and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and SG-40, or the California Code of Regulations, Title 17 Section 94509, VOC standards for cleaning products.
- D. Refer to Division 01 for a complete list of ESDS Prerequisites and Credits anticipated for the project. The Contractor shall coordinate with the General Contractor and Architect to provide documentation and support for all applicable Prerequisites and Credits including but not limited to:
 1. See architectural drawings & specs for ESDS Checklist Prerequisites.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to International Building Code with local amendments, Fire Marshal, and UL for fire resistance ratings and surface burning characteristics.
- B. Voltage Drop: Total voltage drop across feeder plus branch circuit shall be limited to 5% per Energy Code requirements.
 1. Refer to Branch Circuit Length Limit schedule in the drawings for required conductor sizes on branch circuits to limit voltage drop.
 2. The Electrical Contractor shall coordinate conductor sizes with equipment provided. Where voltage drop requires conductors larger than can be landed on a piece of equipment, the Contractor shall provide a junction box nearby in an accessible ceiling or back of house area and reduce conductor sizes as allowed by Code. Installation to meet all Code and AHJ requirements.

1.6 PRODUCT SUBSTITUTIONS

- A. Manufacturers and models of equipment and material indicated in Divisions 26, 27 and 28 Specifications and on drawings are those upon which the electrical design is based and upon which the fire alarm and low voltage systems' designs are to be based; other manufacturers with products considered equal in general quality may also be listed without specific model designation. Manufacturers not listed shall be submitted for approval prior to submission of Bid by the Contractor, see Division 01.
- B. Any equipment other than the basis of design is considered a substitution; this includes equipment from any alternate manufacturers listed without specific model designation in the Contract Specifications and / or Drawings.
- C. Pre-Bid Substitutions will be evaluated based on product manufacturer only. Specific product model, specifications, options and accessories will be evaluated during submittals. Approval of a manufacturer substitution does not constitute approval of the submitted product.
- D. In selecting substitute equipment, the Contractor is responsible for and shall guarantee equal performance and fit. Cost of redesign and all additional costs incurred to accommodate the substituted equipment shall be borne by the Contractor.
- E. Approval of proposed substitution does not grant the Contractor approval for deviation from the contract requirements.

1.7 DESIGN DRAWINGS

- A. All drawings, specifications and calculations prepared by the Fire Alarm Design-Build Contractor shall be stamped by an Engineer currently registered in the State of Washington.
- B. The Fire Alarm and Low Voltage Design-Build Contractor shall submit drawings and diagrams for review and for job coordination:
 - 1. Permit / Construction Drawings for review. These drawings shall be submitted at two milestones as selected by the Architect in electronic PDF format.
 - a. The Contractors' drawings shall match the layout of the Architectural drawings.
 - b. Fire Alarm systems shall be provided in a separate set of drawings by the Fire Alarm Contractor.
 - c. Separate drawings shall be provided for Low Voltage systems unless the drawings are set up to the scale of 1/4" = 1'-0" or larger.
 - d. The Drawing Sets shall include at a minimum:
 - 1) Symbols, Legend and drawing list sheets.
 - 2) Equipment Schedules, Connection Schedules, etc.
 - 3) Low Voltage Systems (Telecom, CATV, access control, etc) floor plan drawings.
 - 4) Low Voltage Systems riser diagrams.

- 5) Fire Alarm System sheets and calculations approved by the local Fire Marshal/ AHJ.

1.8 ELECTRICAL SYSTEMS STUDIES

- A. As soon as the actual equipment being provided by the project has been selected by the Contractor, the Electrical Contractor shall perform Short Circuit / Fault Current, and Arc Flash Studies for the actual Electrical System to be installed.
- B. These studies shall be prepared for the specific electrical equipment, overcurrent devices, utilization equipment and feeder and circuit lengths and types to be installed for the project.
- C. Studies shall be prepared and stamped and signed by a professional Electrical Engineer currently registered in Washington State.
- D. Studies shall be submitted with the Submittals for electrical panelboards, switchboards, overcurrent protective devices, etc. These equipment and devices will not be approved without the required Studies.
- E. See Specification Section 26 05 73 for additional information and requirements.

1.9 SUBMITTALS

- A. Provide one electronic copy of product data submittals for all products listed under “Part 2 Products” of Divisions 26, 27 and 28 Specification Sections and all additional products noted on drawings or required for completion of sequence of operations.
- B. Provide the Submittals so as not to delay the construction schedule; allow at least two weeks for review of each submittal and re-submittal.
- C. Electronic: Submittals shall be complete in one PDF file for each Division with bookmarks for each Specification Section and Principal Category. Multi-file submittals will be returned without review.
 - 1. First Page: Name of Project, Owner, Location & Contracting Company.
 - 2. Index Page: List of specification sections and principal categories with contents by Tag or item.
 - 3. Bookmarks: Electronic bookmark of each specification section and principal category corresponding to listing in index.
- D. Clearly indicate on each page the equipment schedule designation (Tag or Mark) and/or specification section, as applicable. Indicate selected model and all accessories intended for use.
- E. Equipment vendor cover page with contact information shall precede submittal by that vendor.
- F. Submitted product information shall include but not be limited to the following information (as applicable):
 - 1. Product description.

2. Manufacturer and model.
 3. Dimensions.
 4. Performance Ratings.
 5. Construction Materials.
 6. Finish.
 7. Ratings (i.e. UL, ASTM, NEMA, etc).
 8. Electrical characteristics (Voltage, Phase, Wattage, Breakers, etc).
 9. Engineering technical data.
 10. Sound level data.
 11. Vibration isolation.
 12. Strength and fastening provisions.
 13. Seismic qualification data.
 14. Controls and wiring diagrams.
 15. Accessories.
- G. Where a third-party structural engineer has been engaged by the Contractor to provide support, anchoring and seismic calculations, the Contractor shall include these calculations and designs in their Submittal Package.
- H. If requested in subsequent Specification Sections or by the Architect or Engineer, submit Manufacturer's Installation Instructions on any equipment, procedures, or certifications so requested.
- I. Do no ordering, fabrication or manufacturing of products until return of approved submittals.
- J. The Contractor agrees to pay for the Engineer's review cost of the Division 26, 27 and 28 Submittals beyond one resubmittal where resubmittals are required due to deficiencies in the Contractor's Submitted material.

1.10 SHOP DRAWINGS

1. For Electrical Gear (switchboards, panelboards, etc).
 2. For Lighting Control Systems.
 3. Slab plans marked up with all penetrations required for electrical, fire alarm and low voltage systems. Sizes of penetrations shall be indicated on the plans and penetration locations shall be dimensioned from major building lines. The Contractor shall submit these slab plans to the Architect for review.
 4. As requested in subsequent Division 26, 27 and 28 Specification Sections.
 5. For all special or custom-built items or equipment.
 6. In all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by the Engineer for purposes of clarification of the Contractor's intent.
 - a. By submission of revised design shop drawings, the Contractor acknowledges that coordination has been done with all other trades to ensure that all equipment fits and remains accessible with all Code required clearances and that no conflicts exist.
- B. The Architect's and Engineer's review of shop drawings shall not relieve the Contractor of the responsibility for deviations from the Contract drawings or

specifications, unless he has, in writing, called the attention of the Architect to such deviations at the time of the submission, nor shall it relieve him from responsibility for errors or omission in such shop drawings.

1.11 ILLUMINANCE CALCULATIONS

- A. The Contractor shall include illuminance calculations **for all substitution request packages** for the project. Luminaire Submittals will not be approved until illuminance calcs are received.
- B. Illuminance calculations shall include legible calculation points based on a calculation zone with row and column spacing of calculation points at no more than:
 - 1. 1 ft x 1 ft for interior areas.
 - 2. 5 ft x 5ft for exterior areas.
- C. Illuminance calculations shall include a table showing all luminaires included, the files used for each, and the assumed light loss factors (LLF).
 - 1. Calculation zones shall be named in ways that make it easy to identify each location (Office 130, Corridor 125, exterior sidewalk east, etc).
 - 2. Floor Plans and Site Plans provided shall include boundaries between calculation zones and the names of all zones.
- D. Illuminance calculations shall include a table showing the following for each calculation zone:
 - 1. Average illuminance.
 - 2. Minimum illuminance.
 - 3. Maximum illuminance.
 - 4. Max:Min Ratio.
 - 5. Ave:Min Ratio.

1.12 ESDS RELATED DOCUMENTATION AND ACTIVITIES

- A. Provide commissioning documentation as required the Commissioning Authority (CxA) and owner.
- B. Comply with IAQ Management Plan by the general contractor.
- C. Construction Waste Management: Retain and submit all trip and tip tickets for all construction debris and waste removed from site, indicating material content, tonnage, date hauled and facility to where materials were hauled. This submittal is to the general contractor only.

1.13 UTILITY SERVICES

- A. The Contractor shall verify the locations of any overhead or buried utilities on or near the Project site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.
- B. DEMOLITION OF EXISTING SERVICES
 - 1. The Electrical Contractor shall coordinate with all utility service providers that serve the site (power, telecom, CATV, etc) to schedule the

disconnection of all existing utility services on or serving the site that are to be demolished. See the Civil plans for additional information and requirements.

2. The Electrical Contractor shall coordinate with the General Contractor and the utility service providers to ensure that all existing utility services (power, telecom, CATV, etc) equipment, conduit, conductors, etc to be demolished are removed from the Project Site. See the Civil plans for additional information and requirements.

C. TEMPORARY (CONSTRUCTION) POWER

1. The temporary (construction) power system is design-build by the Electrical Contractor.
2. The Electrical Contractor shall design, permit, and install the temporary (construction) power system for the site.
3. The Electrical Contractor shall coordinate temp service requirements with the General Contractor.
4. The Electrical Contractor shall coordinate temp service to the site with the Electrical Utility.
5. The Electrical Contractor shall include in their Bid all costs associated with the design and installation of the temp power system per the requirements of the General Contractor, AHJ, and Utility.

D. NEW PERMANENT SERVICES

1. The Electrical Contractor shall coordinate scheduling and installation requirements with all Utility Service providers for the project (power, telecom, CATV, etc).
2. The Electrical Contractor is responsible for scheduling all Inspections required by the utility service providers in a timely manner, per the requirements of the utility service providers, so as not to delay construction.
 - a. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work (including the electric and telecom utility providers for utility service infrastructure work).
 - b. Should any work be enclosed or covered up before such inspection and testing, the Contractor shall at his own expense uncover said work, and after it has been inspected, tested and approved, make all repairs as necessary to restore all work disturbed by him to its original condition including paying other trades to repair work under their scope that was disturbed.
3. The Electrical Contractor shall confirm final installation requirements for all utility service infrastructure (conduit sizes, locations and routing; vault/pad locations and sizes; pull box locations and sizes; in-building vault installation requirements; final connection point locations; etc) with the Inspectors of the utility service providers serving the project.
4. All utility service infrastructure (conduits, pull vaults, equipment vaults, pull boxes, etc) shall be provided and installed per the requirements of the utility service providers.

1.14 COMMISSIONING

- A. See Division 01 and individual Section 27, and 28 Spec Sections for additional roles and responsibilities of commissioning.
- B. Provide all necessary commissioning assistance, equipment and documentation as required by the Commissioning Plan.
- C. The duty and responsibility for electrical and low voltage commissioning work shall be assigned to a specific individual. Inform the General Contractor and Commissioning Agent of the contact information for the person so assigned.
- D. Perform corrective actions needed to resolve deficiencies identified during commissioning. Record action taken on commissioning deficiency log.

1.15 PLAN REVIEW AND PERMITS

- A. See Specification Section 28 46 00 for Fire Alarm Systems Permit requirements.
- B. In addition to the requirements in other Specification Sections, the Electrical Contractor shall make all required submissions to the Authorities Having Jurisdiction (AHJ) for Plan Review, Permits and approval. The Contractor shall pay all fees related to said submissions and shall submit all comments received from the AHJ to the Architect and Engineer.
- C. The Contractor shall not commence work until a permit (or “get started” permit where allowed by the AHJ) is obtained. The Contractor is solely responsible for ensuring that the permit application and any revisions are submitted in a timely manner so as not to impact the project schedule.
- D. The Contractor shall retain the services of a third-party structural engineer to provide support, anchoring and seismic calculations for all applicable equipment where required by the AHJ.

1.16 QUALITY ASSURANCE

- A. The Contractors shall perform all work per current versions of all applicable Codes and Standards with state and local amendments – see “Codes and Standards” paragraph above.
- B. All equipment and devices shall be UL-Listed and Labeled and shall be acceptable to the Authority Having Jurisdiction as suitable for the use and location for which they are intended.
- C. Provide all like items (receptacles, circuit breakers, electrical gear, etc) from one manufacturer.

1.17 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in Divisions 26, 27 and 28 Specification Sections with a minimum of three years’ experience.

- B. Installer: Company specializing in performing Work included in Divisions 26, 27 and 28 on projects of similar type and scale with a minimum of three years' experience.

1.18 SCHEDULING

- A. Coordinate and provide assistance in final adjustment and testing of life safety systems with the General Contractor and Fire Authority.

1.19 DELIVERY, STORAGE AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. The Contractor shall keep all equipment, devices, conduit, etc in a dry, secured, protected area. The location shall be coordinated with the Architect and General Contractor prior to the start of Construction. See Division 01 for additional delivery, storage and handling requirements.
- C. Where original packaging is insufficient, provide additional protection. Maintain protection in place until installation.
- D. Inspect all products and materials for damage prior to installation.
- E. Protect conduit from all entry of foreign materials by providing temporary end caps or closures on conduit and fittings.
- F. Protect materials and finishes during handling and installation to prevent damage.
- G. Comply with manufacturer's installation instruction for rigging, unloading and transporting equipment.

1.20 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.
- B. Coordinate with General Contractor to have ventilation provided in areas to receive solvent cured materials.
- C. Do not install underground conduit when bedding is wet or frozen.
- D. Do not install equipment pads when ground is frozen or muddy.

1.21 FIELD MEASUREMENTS

- A. Verify field measurements prior to ordering gear.
- B. Verify by field measurements that equipment sizes and configurations are compatible with wall construction and layout.

- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining and documenting exact locations of existing systems.

1.22 COORDINATION

- A. The Contractor shall visit the site and become familiar with existing conditions affecting work. The Contractor shall include in their Bid the costs for all work and / or materials required to comply with the requirements of the Contract Documents based on the actual existing conditions. Failure to visit the Site and verify actual existing conditions does not relieve the Contractor of these requirements; no change orders will be paid due to lack of verification of existing conditions whether they are specifically noted in the Contract Documents or not.
- B. The Contractor shall verify the locations of any overhead or buried utilities on or near the Project site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.
- D. Where the word 'verify' is used on the documents, the contractor shall field verify the existing conditions and modify the scope of the installation as required to meet the verified conditions without additional cost to the Owner.
- E. Where the drawings or specifications call out for the contractor to field verify and / or coordinate locations and requirements this verification / coordination is to be completed prior to any equipment, devices, supports, conduits, etc are installed / roughed-in. Any equipment, devices, supports, conduits, etc installed at locations unacceptable to the design team (either for aesthetics or functionality) due to the contractor failing to field verify / coordinate shall be relocated at the contractor's expense.
- F. Electrical and Low Voltage Systems drawings are diagrammatic and do not indicate all possible site conditions. The contractor shall verify all measurements, dimensions and connections on site and coordinate between trades to preclude interferences. The contractor shall provide adjustments as necessary to fit actual conditions.
- G. The scale of each drawing is relatively accurate, but the Contractor is warned to obtain the necessary dimensions for any exact takeoffs from the Architect. No additional cost to the Owner will be considered for failure to obtain exact dimensions where not clear or in error on the drawings. Any device or equipment roughed in improperly and not positioned on implied centerlines or as required by good practice shall be repositioned at no cost to the Owner.
- H. In the event of a conflict with other trades of work, the following priority from highest to lowest shall be followed: Structural, lighting, HVAC, plumbing/piping and sprinklers. Starting with the lowest priority, the Electrical, HVAC, plumbing,

and sprinkler contractors shall provide whatever materials, offsets, labor etc. is required to resolve the conflict.

- I. Advise the Architect of any modifications required to suit the equipment furnished. Costs for modifications due to equipment substitution will be borne by the contractor.
- J. When discrepancies occur between plans and specifications, the Architect will determine which takes precedence and the Contractor shall perform the selected requirement at no additional cost.
- K. Wherever conflicts occur between different parts of the Contract Documents the greater quantity, the better quality, or larger size shall prevail unless the Architect informs the Contractor otherwise in writing.
- L. Coordinate trenching, excavating, bedding, backfilling of buried systems with the requirements of the Contract Documents.
- M. Coordinate wall openings, rough-in locations, concrete housekeeping pads, and conduit rough-in locations to accommodate Work of Divisions 26, 27 and 28.
- N. The Contractor shall coordinate with the Architectural plans and Project structure when locating equipment and devices and routing conduit and cabling.
- O. The Contractor shall coordinate with the General Contractor and provide slab plans marked up with all penetrations required for electrical, fire alarm and low voltage systems. Sizes of penetrations shall be indicated on the plans and penetration locations shall be dimensioned from major building lines. The Contractor shall submit these slab plans to the Architect for review.
- P. The Contractor shall coordinate conduit and cabling routing and equipment and device locations with all other trades to ensure all Code required clearances are maintained and equipment and devices remain accessible after the work of all trades is complete.
- Q. The Contractor shall consult the approved shop drawings of all other trades and crafts to ensure coordination with final locations of cabinetry, counters, appliances, equipment, structural members, etc. Conflicts are to be resolved with the Architect and General Contractor prior to rough-in. The Contractor shall not be paid for relocation work (including cutting, patching, and finishing) required due to a lack of coordination prior to installation.
- R. See the Architectural drawings for the exact locations of electrical and low voltage devices. The Contractor shall make minor changes (less than 6-feet in any direction) in the location of conduit, boxes, devices, etc from the locations shown in the drawings without extra charge to the Owner where required by coordination or if directed by the Architect or Owner.
- S. The Electrical Design-Build Contractor shall coordinate with the mechanical and plumbing contractors to ensure that the electrical services and disconnects/starters/etc for all HVAC and plumbing equipment are appropriately

sized and that all HVAC and plumbing loads are included in the electrical load calculations.

- T. Short-Circuit Current Rating (SCCR): Coordinate final available fault currents per the Electrical Systems Studies with the Mechanical Contractor to ensure HVAC and refrigeration equipment have an SCCR rating as needed to meet Code requirements.
- U. Motor Starters: By mechanical equipment manufacturer where factory mounted controls are provided. Variable frequency drives by Division 23. All other starters are to be provided by Electrical Contractor; coordinate with Mechanical and Plumbing Contractors to ensure compatibility with their equipment.
- V. Wiring for HVAC Equipment:
 - 1. Power Wiring for HVAC equipment: By Electrical Contractor.
 - 2. Control Wiring for HVAC equipment: Responsibility of Division 23.
 - 3. Owner will not entertain additional cost due to lack of coordination between HVAC Contractor and Electrical Contractor.

1.23 PROJECT CLOSEOUT

- A. Completion, submission and approval of the following is required for final project closeout:
 - 1. Walk through the Project with the Owner and Architect to make note of deficiencies.
 - 2. Execution of Owner's, Architect's and Engineer's final observation reports (punchlist).
 - 3. Operating and Maintenance Instructions.
 - 4. Operating and Maintenance Manual.
 - 5. Equipment and Lens Cleaning.
 - 6. Record Drawings.
 - 7. Testing.
 - 8. Commissioning and Commissioning Report.
 - 9. Warranty.
- B. See other Division 26, 27 and 28 Specification Sections for additional requirements.
- C. See Division 01 for additional requirements.

1.24 OPERATING AND MAINTENANCE INSTRUCTIONAL TRAINING

- A. General: In addition to requirements of Division 01, following initial operation of Electrical systems and prior to acceptance by the Architect, perform the following services:
 - 1. At least two weeks prior to each instruction period, give written notification of readiness to proceed to the Architect and Owner, and obtain mutually acceptable dates.
 - 2. Conduct demonstrations and instructions for the Owner's representatives, pointing out requirements for operating, servicing and maintaining equipment and systems. Describe general system operation and specific

- equipment functions. Cover all equipment calibration, lighting controls setpoint and system adjustment, and safeties and alarms.
3. Furnish qualifications of Contractor's personnel in charge of the instruction; foreman position is minimum acceptable. Where equipment startup is performed by supplier's or manufacturer's personnel, those personnel should also provide training on that equipment.
 4. During demonstrations and instructions include and reference information from maintenance manuals and contract drawings.
 - a. Provide documentation of all instruction which includes:
 - 1) Date and time of instruction.
 - 2) Name, affiliation and qualifications of the instructor.
 - 3) Name and affiliation of the attendees.
 - 4) Topics, systems, and equipment covered.
 - 5) Length of instruction.
 5. Minimum duration of instruction periods:
 - a. Electrical Power Systems 2 hours
 - b. Lighting Control Systems 2 hours
 - c. Fire Alarm Systems See Section 28 46 00
 - d. Low Voltage Systems See Section 27 00 00

1.25 OPERATING AND MAINTENANCE MANUALS

- A. Contents: Furnish, in accord with Division 01, one PDF and one bound copy of operating and maintenance manuals to include the following:
 1. The Job name and address.
 2. Names, addresses and telephone numbers of the Contractor, sub-contractors and local companies responsible for maintenance of each system or piece of equipment.
 3. Manufacturers, suppliers, contractor names, addresses and phone numbers.
 4. Written guarantees.
 5. Warranty service contractors' names, address and phone numbers (if different from above).
 6. Copies of approved brochures and Shop Drawings as applicable for all submittal items.
 7. Manufacturer's printed operating procedures to include start-up and routine and normal operating instructions; and control, shutdown, and emergency instructions.
 8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; and adjusting instructions.
 9. Part numbers of all replaceable items.
 10. Control diagrams and operation sequence.
 11. Record drawings corrected and completed.
 12. Completed systems start-up forms and checklists.
 13. Final copy of testing reports.
- B. Operation and Maintenance Data:
 1. Include spare parts lists for all equipment as applicable.
 2. Submit installation instructions, adjustment instructions, and spare parts lists for all equipment.

3. Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 4. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.
- C. Binders:
1. Furnish typewritten or printed index and tabbed dividers between Specification Sections and principal categories.
 2. Bind each manual in a hard-backed loose-leaf binder.
 3. Imprint on Cover:
 - a. Name of Project.
 - b. Owner.
 - c. Location of project.
 - d. Architect.
 - e. Contractor.
 - f. Year of Completion.
 4. Imprint on backing:
 - a. Name of Project.
 - b. Year of completion.
- D. PDFs:
1. Provide PDF with bookmarks for each Specification Section and Principal Category.
 - a. First Page: Name of Project, Owner, Location & Contracting Company.
 - b. Index Page: List of specification sections with contents by Tag or item.
 - c. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- E. Submittal:
1. Preliminary Copies: Prior to scheduled completion of the project, submit one PDF copy for review by the Architect.
 2. Final Copies: After approval of the preliminary copy, submit one PDF and one bound copy to the Owner.

1.26 RECORD DRAWINGS

- A. Prepare record documents in accordance with the requirements of Division 01 Specification Section "Contract Closeout."
- B. Label each drawing as "Record Drawing" with Electrical Contractors' name and date.
- C. During construction, maintain an accurate record set of the drawings of the installation on project site at all times; keep this set in a safe location, protected from the environment.
- D. Submit one digital file with all drawings in PDF format.
- E. Make all notes and revisions on PDF set in red.

- F. In addition to the requirements specified in Division 01 and in other Division 26, 27 and 28 Specification Sections, indicate installed conditions (locations, sizes, burial depths, arrangements, etc) for:
1. Major raceway systems – Interior and Exterior – dimensioned from prominent building lines.
 2. Utility service conduit (power and telecom) and connections, dimensioned from prominent building lines.
 3. Conduits provided for future use with intended future use identified, dimensioned from prominent building lines.
 4. Control devices, equipment disconnects, distribution and branch electrical circuitry, and fuse and circuit breakers.
 5. Equipment locations (exposed and concealed) shown to scale and dimensioned from prominent building lines.
 6. Final schedules for panelboards, lighting controls, etc.
 7. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.27 TESTING

- A. Provide completed start-up forms and checklists.
- B. Perform testing of electrical, lighting control, non-utility metering, fire alarm and other low voltage systems as described in Division 26, 27 and 28 Specification Sections and as required by applicable codes and ordinances.
- C. Written verification of testing to be signed by Owner's Representative.

1.28 COMMISSIONING REPORT

- A. Provide commissioning in compliance with Energy Code requirements, the commissioning notes in the contract documents and per the Project's Commissioning Plan.
- B. Submit copies of the preliminary commissioning report as required by the Washington State \ Seattle Energy Code and as outlined on drawing commissioning notes and specifications. This report is an execution and fulfillment of the commissioning plan. This report shall be completed before the final electrical permit inspection. At a minimum this report shall include:
1. Testing reports for systems required to be commissioned.
 2. Complete system startup checklists.
 3. Functional test reports.
 4. Sequence of Operation test reports.
 5. O&M Materials.
 6. Record Drawings.
 7. Owner training documentation.
 8. Notes of any discrepancies observed during testing and any corrective actions taken or date when corrective action will be taken.
 9. Notes of any tests which could not be performed due to conflicts (identify specific conflict that prevented testing from occurring).
- C. After receiving review comments from the preliminary commissioning plan make corrections indicated and submit three (3) copies of the final commissioning

report. At a minimum this report shall include the information from the preliminary commissioning report and the following:

1. Corrective measures taken in response to preliminary report or field observation report.

1.29 WARRANTY AND CONTRACTOR'S GUARANTEE

- A. All work, material and equipment shall be free of defect, complete and in perfect operating order at time of delivery to Owner.
- B. The Contractor shall, without cost to the Owner, correct all defects and failures discovered within one year from date of final acceptance for all electrical, fire alarm and low voltage systems, except when in the opinion of the Architect a failure is due to neglect or carelessness of the Owner.
 1. See individual Specification Sections for additional requirements.
- C. The guarantee of the Contractor is independent of shorter time limits by any manufacturer of equipment furnished. Submit with Operation and Maintenance Manual all guarantees which exceed one year.
- D. The Contractor shall make all necessary lighting and receptacle control adjustments during first year of operation.
- E. The presence of any inspector or observer at any point during construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.
- F. Refer to Division 01, 26, 27 and 28 Specification Sections for additional Warranty requirements.

PART 2 NOT USED

PART 3 EXECUTION

3.1 DOCUMENTATION

- A. Additional plan submittals to reviewing authority: If additional drawing submittals are required at any time during construction the Contractor shall submit drawings, review with authority, and pick up subsequent approved drawings. The Engineer will revise and/or prepare electrical drawings for submittal. The Design Build Fire Alarm Contractor will revise and/or prepare Fire Alarm, two-way communications, and DAS system drawings for submittal.

3.2 MOCK-UPS

- A. The Electrical Contractor shall mock-up the common areas (as determined by the Architect and Owner) by marking the intended locations of all equipment and devices (load centers, media boxes, luminaires, switches, receptacles, CATV and telecom outlets, thermostats, heaters/ HVAC equipment, etc).

- B. Before starting installation of equipment and devices, the Electrical Contractor shall walk through all mocked-up areas with the Owner, Architect, and General Contractor to receive approval for all locations.
- C. The Electrical Contractor shall relocate equipment and devices in the mock-ups per the Owner and Architect's instructions.
- D. The Electrical Contractor shall relocate any equipment and devices installed prior to the approval of the mocked-up areas by the Architect and Owner at the Electrical Contractor's expense.

3.3 INSTALLATION

- A. The Contractor shall conceal all conduit, cabling and boxes in finished areas unless indicated otherwise or granted specific permission by the Architect. Install all conduit and cabling perpendicular to or parallel with building lines wherever possible.
- B. In open ceiling areas, all cabling shall be installed in conduit. In front of house (public) areas, conduit shall be painted; color as selected by the Architect.
- C. Coordinate the locations of luminaires, lighting control devices and outlets with all other trades.

3.4 INSPECTION

- A. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work (including the electric and telecom utility providers for utility service infrastructure work).
- B. Should any work be enclosed or covered up before such inspection and testing, the Contractor shall at his own expense uncover said work, and after it has been inspected, tested and approved, make all repairs as necessary to restore all work disturbed by him to its original condition including paying other trades to repair work under their scope that was disturbed.

3.5 FIELD QUALITY CONTROL

- A. Conducts tests of equipment, devices, and systems as required by NFPA, BICSI, local Codes and the local AHJ.
 - 1. Provide a Journeyman Electrician with all tools, instruments, etc required to complete required tests.
 - 2. Coordinate with the Owner, Architect and General Contractor; tests should be performed in the presence of the Owner and Architect unless given specific permission otherwise in writing.
- B. Refer to individual Division 26, 27 and 28 Specification Sections for additional requirements.

3.6 CLEANING

- A. Clean adjacent surfaces of fire stopping materials.

- B. Clean interior and exterior of all equipment and luminaire lenses. Equipment shall be free of dirt, construction debris, corrosion, etc.
- C. Adequate provisions shall be made during construction to eliminate dirt, debris or other material from entering and collecting inside of conduit and equipment. Any collection of material shall be thoroughly cleaned before owner occupancy.
- D. Clean exterior of all exposed conduit.
- E. Use ESDS Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's per ESDS requirements and contain no added urea-formaldehyde.

3.7 CUTTING, FITTING, REPAIRING AND PATCHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where necessary for installation of electrical work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting where possible by setting sleeves, frames, etc., and by coordinating for openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for electrical installations.
- C. Cut all holes neatly and as small as possible to admit work. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.8 SALVAGE

- A. Remove excess conduit and conductors. Remove scrap and all other excess materials from the site.
- B. Comply with contractor's Construction Waste Management Plan. Retain and submit all trip and tip tickets for all construction debris and waste hauling, indicating material content, tonnage, date hauled and facility to where materials were hauled.

3.9 MANUFACTURERS' FIELD SERVICES

- A. Refer to individual Division 26, 27 and 28 Specification Sections for requirements.

3.10 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 00 00

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hangers and Supports.
 - 2. Concrete Bases.
 - 3. Vibration and Seismic Controls.
 - 4. Sleeves and Sleeve Seals.
 - 5. Firestopping.
 - 6. Access Panels.
 - 7. Execution.

1.2 RELATED SECTIONS

- A. In addition to the requirements in Divisions 01, 26, 27 and 28 Specification Sections, see also the following Specifications for additional information and requirements:
 - 05 50 00 METAL FABRICATIONS
 - 03 30 00 CAST-IN-PLACE CONCRETE
 - 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE
 - 07 84 13 PENETRATION FIRESTOPPING
 - 09 91 13 EXTERIOR PAINTING
 - 09 91 23 INTERIOR PAINTING
 - 09 96 00 HIGH PERFORMANCE COATINGS

1.3 GENERAL REQUIREMENTS:

- A. The Contractor shall retain the services of a third-party structural engineer currently licensed in the State of Washington to provide hangers, restraint, support, anchoring and seismic calculations and details for all applicable equipment where required by the AHJ.
- B. The Contractor shall design supports for equipment, devices and raceways capable of supporting the combined weight of the supported systems and their contents. Anchoring, support and seismic restraint systems shall meet the requirements of applicable Codes with local amendments and the requirements of the Project Structural Engineer and the local AHJ. See the Structural drawings and specifications for requirements.
- C. Seismic Performance:
 - 1. The Contractor shall provide seismic support as required by IBC 1613 with local amendments, the local AHJ and the project Structural Engineer.
 - 2. Seismic restraint and hangers and supports systems shall meet the seismic performance requirements of the Project's Structural Engineer and as per the requirements of Code and the local AHJ. See the Structural drawings and specifications for requirements.

- 3. The supported equipment and/ or devices will remain in place without any separation and will be fully operational after a seismic event of a strength per Structural and Code/ AHJ requirements.
- D. Field Welding shall comply with AWS D1.1/D1.1M and D1.2/D1.2M as applicable.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- F. ESDS-Compliant Products: Inside the building envelope, use materials (including but not limited to adhesives, sealants and solvents) that contain acceptable or lower levels of VOC per referenced standards in Rating System Requirements and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and SG-40, Title 17 Section 94509, VOC standards for cleaning products.

1.4 REQUIREMENTS

- A. Provide major equipment components with manufacturer's name, address, catalog number and capacity indicated on a nameplate, securely affixed in a conspicuous place.
- B. Protect stored material and equipment against weather, corrosion and dirt. Protect installed electrical, fire alarm and low voltage systems components and equipment against weather damage, corrosion, dirt and construction dust. Seal equipment and conduit where and when necessary to be kept clean and weathertight.
- C. Furnish standard and fabricated hangers and supports complete with necessary inserts, bolts, nuts, rods, washers and other accessories.
- D. Provide vibration isolation on all transformers and motor driven equipment provided by the Electrical Contractor.
- E. Provide structural work and equipment required for expansion and contraction of conduit. Verify anchors, guides, and expansion joints provide and adequately protect system.
- F. Installed hangers, supports and restraints (as applicable) shall have a flame rating of Class 1 and shall be self-extinguishing per ASTM D635 when tested per ASTM 84 requirements unless the requirements of Code or the local Fire Marshal or AHJ are more stringent.
- G. Firestop interruptions to fire rated assemblies, materials and components.
- H. Firestopping Materials: Provide to achieve fire ratings as noted on architect's drawings for adjacent construction, but not less than 1 hour fire rating. ASTM and UL.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes or

- otherwise indicated on architectural or structural drawings or specifications.
- 2. Surface Burning: UL 723 with maximum flame spread / smoke developed rating of 25/50.
 - a. For nonmetallic slotted channel systems and accessories: Comply with ASTM E84. Flame Rating Class 1. Self-extinguishing per ASTM D635.
- 3. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 SUBMITTALS:

- A. Provide product data for each type of product in Part 2 below. Mark on submittals specific equipment and devices intended for installation on product where multiple equipment and/ or devices are shown on a single catalog page. Include rated capacities and furnished specialties and accessories.
 - 1. Provide Shop Drawings for specially fabricated seismic restraint and hanger and support systems stamped by an Engineer currently registered in the State of Washington. Include design calculations for hangers and seismic restraints.
- B. See Specification Section 26 00 00 "Electrical General Conditions" for additional requirements.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Manufacturers: Contingent upon meeting requirements of the Project, Code and local AHJ, provide products by one or more of the following:
 - 1. Allied Tube & Conduit
 - 2. Appleton Electric
 - 3. Calbrite; a part of atkore International
 - 4. Cooper (Eaton) B-Line, Inc.
 - 5. ERICO Global Company; part of Pentair.
 - 6. Cully-Minerallac Company.
 - 7. O-Z / Gedney; Emerson Electric Co.
 - 8. Thomas & Betts Corporation.
 - 9. Unistrut; a part of atkore International.
- B. Metallic Slotted Support Systems
 - 1. Comply with Metal Framing Manufacturers Association Standard Publication MFMA-4.
 - 2. Channels:
 - a. Channels shall be galvanized steel / stainless steel, Type 304 / stainless steel, Type 316 / 6063-T5 aluminum alloy.
 - b. Channel widths shall be as required for the applicable load criteria and per requirements of the structural engineer.
 - 3. Fittings and Accessories shall be galvanized steel / stainless steel, Type 304 / stainless steel, Type 316 / 5052-H32 aluminum alloy.
 - 4. Coatings:

- a. Metallic: Hot-dip galvanized after fabrication; applied per MFMA-4 / zinc plated according to ASTM B633.
 - b. Painted: Manufacturer's standard painted coating applied per MFMA-4. Protect finishes from damage during shipping.
- C. Support Devices for Conduit and Cable:
 - 1. Designed for type and size of conduit / cabling being supported.
 - 2. Material: Steel / Stainless Steel.
- D. Support Devices for Conductors in Vertical Conduit:
 - 1. Designed to adequately support the intended cabling plus safety factors without damaging the insulation or reducing the amount of insulation in the area where the cable is supported.
 - 2. Body Material: Malleable iron.
- E. Fabricated Metal Supports:
 - 1. Design for weight and dimensions of supported equipment plus safety factor; coordinate with third-party structural engineer as required.
 - 2. Material: Black, Galvanized Structural Steel per ASTM A36/ A36M. Comply with Section 05 50 00 for steel shapes and plates.
- F. Components for Mounting, Anchoring and Attachment:
 - 1. Manufacturers: Contingent upon meeting requirements of the Project, Code and local AHJ, provide products by one or more of the following:
 - a. Cooper B-Line, Inc
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.
 - e. Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - f. Unistrut; a part of atkore International.
 - 2. Provide fasteners listed for use in building material where used and with tension, shear and pullout capacities as required to support intended loads.
 - 3. Coordinate with and receive approval from the Structural Engineer for all locations of Powder-Actuated Fasteners prior to installation.
 - 4. Provided threaded steel hanger rods.
 - 5. Concrete Inserts:
 - a. Continuous channel slotted support system.
 - b. Universal, malleable iron - Type 18, FS WW-H-171.
 - 6. Provide beam clamps and attachments as required.

2.2 VIBRATION AND SEISMIC CONTROLS

- A. Vibration Isolators
 - 1. Where pad-style vibration isolators are used, arrange pads in a single or multiple layers so as to allow for uniform loading over the entire pad area as per the direction of the Architect or Acoustic Consultant. Coordinate dimensions with the equipment to be supported. Pads are to be of a resilient material; exact material to be per the Architect or Acoustic Consultant.

2. Spring isolators shall meet the requirements of the Architect or Acoustic Consultant. Provide seismic or limit-stop restrained spring isolators as required for equipment, local AHJ or the Acoustic Consultant.
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Color code springs for load carrying capacity.
 3. For floor-mounted equipment, provide neoprene bushings intended for use for rigid equipment mountings. Match to type and size of equipment anchor bolts and studs.
 4. For wall-mounted equipment, provide neoprene and steel assemblies intended for use for rigid equipment mountings. Match to type and size of anchorage assemblies used.
- B. Seismic Controls
1. Manufacturers: Contingent upon meeting requirements of the Project, Code and local AHJ, provide products by one or more of the following:
 - a. Cooper B-Line, Inc
 - b. Hilti, Inc
 - c. Kinetics Noise Control, Inc
 - d. Mason Industries, Inc
 - e. Unistrut; a part of atkore International
 2. Match equipment seismic control restraints and restraint systems to the type and size of the anchor bolts and studs used. Coordinate with Structural Engineer and General Contractor.

2.3 SLEEVES AND SLEEVE SEALS

- A. Manufacturers: Contingent upon meeting requirements of the Project, Code and local AHJ, provide products by one or more of the following:
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. The Metraflex Company.
 4. Pipeline Seal and Insulator, Inc.
 5. Presealed Systems.
 6. Proco Products, Inc.
- B. Round tube sleeves for penetrations through Non-Fire-Rated floors and walls: 0.0239-inch thick (minimum) galvanized steel.
- C. Rectangular sleeves for penetrations through Non-Fire-Rated floors and walls:
1. Sleeves with a perimeter less than 50 inches and having no side longer than 16 inches: Galvanized steel with minimum thickness of 0.052 inches.
 2. All other rectangular sleeves: Galvanized steel with minimum thickness of 0.138 inches.
- D. Wall Sleeves for penetrations at exterior walls below grade and exterior floors: Cast iron wall pipe with integral waterstop.
- E. Wall sleeves for penetrations at exterior wall penetrations above grade: ASTM A53/A53M Steel pipe sleeves, zinc coated with mechanical sleeve seals.

- F. Sleeve seal fittings for conduit penetrations at slab on grade or below grade exterior walls shall be listed and labeled for embedding in concrete slabs or walls in direct contact with earth and shall have plastic or rubber waterstop collars with center gap matching size of conduit to be installed in each penetration.
- G. Sealing elements in sleeve seal systems used to fill space between sleeve and raceway for conduit penetrations in slabs on grade or below-grade exterior walls shall be interlocking links of EPDM rubber shaped to fit surface of pipe.
- H. Grout shall be non-shrinking and recommended for interior and exterior applications; Grade B, post-hardening and volume-adjusting per ASTM Standard C1107/C1107M.
- I. Where permitted by Code, the local AHJ and the Project Architect in Non-Fire-Rated gypsum assemblies silicone sealants may be used to seal penetrations provided they are listed for the intended use and location.
 - 1. Silicone Sealants are to be of pourable (self-leveling) Grade intended for openings in Non-Fire-Rated horizontal assemblies.
 - 2. Silicone Foams shall expand and cure in place when mixed, resulting in a flexible, non-shrinking foam.
- J. All sealants shall meet the Sustainability requirements of the project. See the General Requirements paragraph of this Specification Section and Division 01 specification for requirements.
- K. Size sleeves large enough to allow for movement due to expansion unless manufacturer's instructions or Structural Engineer directs otherwise. Confirm seismic criteria requirements with structural engineer.
 - 1. At exterior wall and floor penetrations allow for 1 inch of space between raceway and the sleeves for installation of mechanical sleeve seals or sleeve seal systems unless manufacturer's instructions indicate or seismic criteria of project requires otherwise.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Provide access to existing conduit, equipment and other installations remaining active and requiring access.
- B. Extend existing cabling and conductor and conduit installations using materials and methods compatible with existing installations.

3.2 SURFACE PREPARATION

- A. Examine areas and equipment for conditions that would affect performance of the Work. Proceed with installation only after unsatisfactory conditions have been addressed.
- B. Degrease and clean surfaces of any matter that would affect the bond of paint, adhesives or firestopping material.

- C. Remove incompatible materials affecting bond of paint, adhesives or firestopping.
- D. Degrease and clean surfaces to receive adhesive for identification materials.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- F. For adhesive anchors, clean holes and prepare per manufacturer and Structural Engineer's instructions prior to installation.

3.3 COORDINATION

- A. Coordinate the locations of embedded anchors and other connection hardware with equipment attachment points (based on actual equipment to be provided for the project). Locate and avoid the locations of concrete reinforcement, formwork, prestressed tendons, and other embedded items prior to drilling holes.
- B. Coordinate the locations of anchors, supports and seismic control assemblies and hardware with equipment mounting points and locations of concrete reinforcement, prestressed tendons, conduit, etc and other embedded items prior to drilling holes. Do not damage existing reinforcing or embedded items.
 - 1. Notify the structural engineer immediately if any embedded items are encountered during drilling.
- C. Prior to drilling holes allow all concrete and masonry to reach full design strength; coordinate with and receive approval from the Architect and Structural Engineer.

3.4 INSTALLATION – CLEARANCE

- A. Devices, equipment and control components shall be accessible for inspection, service, repair and replacement.
- B. Ensure Code-required clearances are provided at all applicable equipment.

3.5 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying conduit 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, coordinate with General Contractor, Architect and Structural Engineer to drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.6 INSTALLATION – HANGERS AND SUPPORTS

- A. Comply with NFPA 70, NECA 1, NECA 101, NECA 102, NECA 105 and NECA 111 for installation and application of hangers and supports for electrical equipment and systems except if requirements in this Section, Manufacturer's written instructions, Structural Engineer or of the AHJ are stricter.
- B. Install hangers, supports, anchors, etc per Code and manufacturer and Structural Engineer's instructions.
- C. Minimum hanger rod size shall be 1/4-inch (6 mm) in diameter.
- D. Space supports as required by NFPA 70.
- E. Secure raceways and cables with devices approved for the intended use by an agency acceptable to the AHJ. For conduit 1-1/2-inch (38 mm) and smaller above suspended ceilings, spring-steel clamps designed for supporting single conduits without bolts may be used for fastening conduit to trapeze supports.
- F. Size and install support assembly components to meet the present and anticipated future loads with appropriate safety factors. Install hanger rod stiffeners where required to prevent the buckling of hanger rods by seismic forces. Coordinate with structural engineer as required.
- G. Size and install trapeze-style support systems where used such that conduit / cabling capacity can be increased by at least 25% in the future. Coordinate with structural engineer as required.
- H. Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise required by Code or Architectural or Structural drawings or specifications.
 - 1. To Wood: Lag screws or Through Bolts.
 - 2. To New Concrete: Bolt to Concrete Inserts.
 - 3. To Existing Concrete: Expansion Anchor Fasteners.
 - 4. To Hollow Masonry: Approved Toggle-type Bolts.
 - 5. To Solid Masonry: Expansion Anchor Fasteners.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M with lock washers and nuts / Beam Clamps (MSS SP-58, Type 19, 21, 23, 25 or 27) complying with MSS SP-69 / Spring Tension Clamps.
 - 7. To Light Steel: Sheet Metal Screws.
 - 8. To Hollow Walls and Nonstructural Building Surfaces: Mount on slotted channel racks attached to substrate per seismic restraint and anchorage requirements and per structural engineer.
- I. Use:
 - 1. Interior Locations: Zinc-coated steel anchors
 - 2. Exterior Locations: Stainless-steel anchors
- J. Holes for expansion anchors shall be drilled to avoid the need for reinforcing bars.
- K. Protect anchors from damage during installation.

- L. Secure raceways and cabling to trapeze supports in a manner approved by the local AHJ.
- M. Installation shall allow for the free movement of equipment within its intended normal mode of operation.
- N. Install fabricated metal supports per requirements of Specification Section 05 50 00, "Metal Fabrications."

3.7 INSTALLATION – CONCRETE BASES

- A. Concrete bases shall be installed to provide at least 4 inches of base beyond the edges of the equipment supported in both directions unless indicated otherwise on the drawings or unless otherwise required by intended anchoring method.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete unless otherwise required by Architect, Structural Engineer or equipment to be supported.
- C. Anchor equipment to concrete base per manufacturer's written instructions or requirements of Structural Engineer.

3.8 INSTALLATION – VIBRATION AND SEISMIC CONTROLS

- A. Provide hanger rod stiffeners where required by Code, local AHJ or Structural Engineer.
- B. Install vibration and seismic control assemblies and devices per Code, local AHJ, Manufacturer's written instructions, structural engineer and acoustic consultant.
- C. Select and install seismic support assemblies where required to provide adequate strength to carry present and future static and seismic loads within loading limits per the requirements of Code, the local AHJ and the Structural Engineer.
- D. Install resilient bushing assemblies for wall-mounted equipment.
- E. Install resilient, bolt-isolation washers where the clearance between an anchor and the adjacent surface exceeds 0.125 inch (3.2 mm).
- F. Unless otherwise required by Code, the local AHJ or the Structural Engineer, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.
- G. Install flexible connections in raceway, cable trays, busways, etc where they cross seismic joints, where adjacent sections are supported by different structural elements and where terminating to equipment that is anchored to a different structural element than the one supporting them where they approach said equipment.
- H. Installation shall allow for the free movement of equipment within its intended normal mode of operation.

3.9 INSTALLATION – SLEEVES

- A. Comply with NFPA 70, NECA 1, NEMA VE2 and the local Building Codes as applicable for installation and application of sleeves and sleeve seals for electrical penetrations except if requirements in this Section, Manufacturer's written instructions, Structural Engineer or of the AHJ are stricter.
- B. Exterior watertight entries: Seal with mechanical sleeve seals per manufacturer's recommendations for intended penetrations locations and raceway sizes.
 - 1. Center raceway in sleeve. Install mechanical sleeve seals per manufacturer's instructions to make watertight seal.
 - 2. At roof penetrations, seal individual penetrations with flexible boot-type flashing units unless directed otherwise by Architect or Envelope Consultant. Coordinate installation of flashing with the installation of the roof.
- C. Set sleeves in position in and secure to forms as new walls and slabs are constructed. Provide reinforcing around sleeves.
 - 1. Cut sleeves for wall penetrations for mounting flush with both sides of the wall; deburr the sleeves after cutting.
 - 2. Where sleeves are used at floor penetrations, extend the sleeves 2 inches above the finished floor level or as otherwise directed by Architect or Engineer; deburr the sleeves after cutting.
- D. At interior Non-Fire-Rated walls and floors comply with the requirements of Section 07 92 00, "Joint Sealants." The space between the sleeve and raceway shall be sealed with joint sealant or compound intended for the specific application, use and location of the joint. The space outside the sleeves is to be sealed with solidly packed mortar or grout such that no voids remain in the sealing material; smooth exposed surfaces.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk or fireproof airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Protect all sealants while curing.
- G. Size sleeves large enough to allow for movement due to expansion unless manufacturer's instructions or Structural Engineer directs otherwise. Confirm seismic criteria requirements with structural engineer.
- H. At exterior wall and floor penetrations allow for 1 inch of space between raceway and the sleeves for installation of mechanical sleeve seals or sleeve seal systems unless manufacturer's instructions indicate or seismic criteria of project requires otherwise.

3.10 EXAMINATION AND TESTING

- A. Examine anchors and support rough-in work prior to the installation of equipment and raceways to verify actual locations and other conditions potentially affecting the completion of the installation.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. The Contractor shall test at least five of each type and size of installed anchors and fasteners as selected by the Architect to 90 percent of the rated proof load of the device. If any of the test group of the installed anchors and fasteners fail the testing, all others of the same type installed on the project shall also be tested to 90 percent of the rated proof load of the device.
- D. Equipment, devices, anchors, hangers, supports, etc will be considered defective if they do not pass tests and inspections.
- E. The Contractor shall provide a test and inspection report summarizing all tests and inspections in this Section, the results or said tests and inspections, what actions were taken to correct any unsatisfactory conditions and devices, and retesting results confirming that any originally deficient installations have been corrected.

3.11 PAINTING

- A. See Specification Sections 09 91 13 "Exterior Painting" / 09 91 23 "Interior Painting" / 09 96 00 "High Performance Coatings" for requirements.
- B. For galvanized surfaces, after cleaning and preparing surface, apply a galvanizing-repair paint per ASTM A780.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Aluminum building wire rated 600 V or less.
 - 3. Metal-clad cable, Type MC, rated 600 V or less.
 - 4. Armored cable, Type AC, rated 600 V or less.
 - 5. Mineral-insulated cable, Type MI, rated 600 V or less.
 - 6. Service entrance cable, Type SE, rated 600V or less.
 - 7. Fire-alarm wire and cable.
 - 8. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 271313 "Communications Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, an Atkore Brand.
 - 2. Cerro Wire LLC.
 - 3. Encore Wire Corporation.
 - 4. General Cable Corporation.
 - 5. Southwire Company.

2.2 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 or ASTM B496 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type USE-2 and Type SE: Comply with UL 854.
 - 2. Type THHN and Type THWN-2: Comply with UL 83.
 - 3. Type UF: Comply with UL 83 and UL 493.
 - 4. Type XHHW-2: Comply with UL 44.

2.3 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.
- D. Conductor Insulation:
 - 1. Type USE-2 and Type SE: Comply with UL 854.
 - 2. Type THHN and Type THWN-2: Comply with UL 83.
 - 3. Type XHHW-2: Comply with UL 44.

2.4 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.

- 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
 - 1. Single circuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors:
 - 1. Feeders and branch circuits #2 AWG and smaller: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
 - 2. Feeders larger than #2 AWG: Aluminum, complying with ASTM B 800 and ASTM B 801.
- E. Ground Conductor: Bare or insulated.
- F. Conductor Insulation:
 - 1. For Copper MC Cable: Type THHN/THWN-2: Comply with UL 83.
 - 2. For Aluminum MC Cable: Type XHHW-2: Comply with UL 44.
- G. Armor: Aluminum, interlocked.
- H. Jacket: PVC applied over armor.

2.5 ARMORED CABLE, TYPE AC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Comply with UL 4.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
 - 1. Single circuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors:
 - 1. Feeders and branch circuits #2 AWG and smaller: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
 - 2. Feeders Larger than #2 AWG: Aluminum, complying with ASTM B 800 and ASTM B 801.
- E. Ground Conductor: Bare or insulated.
- F. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.
- G. Armor: Aluminum, interlocked.

2.6 MINERAL-INSULATED CABLE, TYPE MI

- A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.
- B. MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pentair.
 - 2. Pyrotenax.
 - 3. Watlow Electric Manufacturing.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. UL 2196 for fire resistance.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper.
- E. Insulation: Compressed magnesium oxide.
- F. Sheath: Copper.

2.7 FIRE-ALARM WIRE AND CABLE

- A. MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following or a pre-approved equal:
 - 1. Allied Wire & Cable, Inc
 - 2. Comtran Corporation.
 - 3. Genesis Cable Products; Honeywell International, Inc
 - 4. Pyrotenax.
 - 5. Superior Essex, Inc.
 - 6. West Penn Wire.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG or as recommended by system manufacturer].
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.8 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-approved equal:
 - 1. 3M; Electrical Products Division.
 - 2. ABB, Electrification Products Division.
 - 3. AFC Cable Systems, Inc.
 - 4. Arlington Industries.
 - 5. Hubbell Power Systems, Inc.
 - 6. O-Z/Gedney; EGS Electrical Group LLC.
 - 7. Thomas & Betts Corporation.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Termination: Compression.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- F. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2 or XHHW-2, single conductors in race-way installed per Code and AHJ requirements.

- B. Exposed Feeders: Type THHN/THWN-2 or Type XHHW-2, single conductors in metallic raceway. For exposed feeders that do not leave the Electrical Rooms and that are not subject to physical damage, the Electrical Contractor may also use Metal-clad cable, Type MC as allowed by Code.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway or Metal-clad cable, Type MC as allowed by Code or service-entrance rated cable, Type SE as allowed by Code.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway or Metal-clad cable, Type MC as allowed by Code.
- F. Feeders in Cable Tray: Cable trays are intended for low voltage systems cabling only; no power conductors or cable are to be installed in the cable tray.
- G. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in metallic raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC or Nonmetallic-sheathed cable as allowed by Code.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC as allowed by Code.
- K. Branch Circuits in Cable Tray: Cable trays are intended for low voltage systems cabling only; no power conductors or cable are to be installed in the cable tray.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. The Contractor shall conceal all conduit, cabling and boxes in finished areas unless indicated otherwise or granted specific permission by the Architect. Install all conduit and cabling perpendicular to or parallel with building lines wherever possible.
- B. In open ceiling areas, all cabling shall be installed in conduit. Conduits shall be painted; confirm finish with Architect.
- C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

- D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- G. Support cables according to Section 260500, "Common Work Results for Electrical."

3.4 INSTALLATION OF FIRE-ALARM WIRING

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method:
 - 1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted other than at open ceiling areas.
 - 3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and

electrical supervision for connecting wiring as needed to suit monitoring function.
Confirm requirements with Design-Build Fire Alarm Contractor.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack unless otherwise noted on drawings.
- D. Comply with requirements in Section 28 46 00 "Addressable Fire-Alarm System" for connecting, terminating, and identifying Fire Alarm System wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260500.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.
 - 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

- b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Continuity test on each conductor and cable.
 - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Foundation steel electrodes.
 - 3. Ground mesh electrode system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product in Part 2.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.
 - 3) Ground rings.
 - 4) Ground mesh system.
 - 5) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, ground mesh system, grounding connections for separately derived systems, based on NETA MTS.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, unless indicated otherwise on drawings provide products by one of the following:
 - 1. ABB, Electrification Products Division.
 - 2. Appleton Electric.
 - 3. Burndy; Hubbell Incorporated.
 - 4. Calbrite; a part of atkore International.
 - 5. ERICO.
 - 6. Harger Lightning & Grounding.
 - 7. ILSCO.
 - 8. O-Z/ Gedney; Emerson Electric, Co.
 - 9. Siemens Industry, Inc.
 - 10. Thomas & Betts Corporation.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Unless indicated otherwise on the drawings or otherwise required by Code, provide the following:
 - a. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - b. Bonding Conductor: No. 2, solid conductor.
 - c. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, sized as required and indicated on drawings, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V. See design drawings for additional requirements and information.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Non-reversible, high-compression type. Provide two-hole lugs and stainless hardware where indicated on drawings or as required by Code/ Local AHJ.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, copper lugs. Rated for 600 A.
- M. Tower Ground Clamps: Mechanical type, copper or copper alloy, see drawings for additional requirements.
- N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- O. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated or stainless-steel bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel with 99.9% pure electrolytic copper coating; 5/8 by 96 inches (16 by 2400 mm).

- B. Ground Ring: Install a grounding conductor, electrically connected to each ground rod and to each indicated item, extending around the perimeter of building as indicated in the design drawings.
- C. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor. Coordinate with the General Contractor to ensure concrete into which ufer ground is encased is in direct contact with earth (i.e. no insulation, vapor barriers, etc). See design drawings for required conductor size and additional information.
- D. Ground Mesh: #6 AWG copper conductor rated for direct burial in a 12-inch mesh at least 18-inches below grade. See design drawings for additional information and requirements.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated in the drawings or specifications.
- B. Underground Grounding Conductors: Install bare copper conductor, size as indicated on drawings.
 - 1. Bury at least 30 inches (750 mm) below grade unless indicated otherwise on drawings or otherwise required by Code.
 - 2. Where conductors come up from concrete or earth, protect conductors with rigid Schedule 40 PVC conduit.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on the drawings.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator. See Grounding System Riser Diagram, drawing E61.01.
- B. Dry-Type Transformers: Ground non-utility transformers per Code requirements. See Grounding System Riser Diagram, drawing E61.01.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Ground all utility infrastructure per Utility requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- E. Utility Transformers: Ground all utility infrastructure per Utility requirements.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-

tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- E. Cable Tray Grounding
 - 1. Ground cable trays according to NFPA 70 unless additional grounding is specified.
 - 2. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
 - 3. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
 - 4. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Ground Ring: Install a grounding conductor, electrically connected to each ground rod and to each indicated item, extending around the perimeter of area indicated on drawings.
1. Install tinned-copper conductor as indicated on design drawings.
 2. Bury ground ring as indicated on design drawings.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor, size as indicated on design drawings.
1. Coordinate with the General Contractor to ensure concrete into which ufer ground is encased is in direct contact with earth (i.e. no insulation, vapor barriers, etc).
 2. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation where in contact with earth.
 3. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- I. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at the service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System: 5 ohms.
 - 2. Panelboards Serving Electronic Equipment: 1 ohm(s).
 - 3. Pad-Mounted Equipment: 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Underground ducts and raceways.
 - 6. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- C. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- D. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- E. GRC: Galvanized rigid steel conduit.
- F. IMC: Intermediate metal conduit.
- G. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
 - 1. Include duct-bank materials, including spacers and miscellaneous components.
 - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.

3. Include accessories for manholes, handholes, boxes, and other utility structures.
 4. Include underground-line warning tape.
 5. Include warning planks.
- B. Shop Drawings:
1. For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
 2. For conduit and raceway support systems, stamped and signed by a Structural Engineer currently registered in the State of Washington.
 3. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design.
 - e. Include grounding details.
 - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - g. Include joint details.
 4. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

1.6 FIELD CONDITIONS

- A. Ground Water: Confirm ground water level with Architect and Civil Engineer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. CONDUITS AND FITTINGS:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-Bid approved equal:
 - a. AFC Cable Systems, Inc.
 - b. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - c. Arlington Industries.
 - d. Carlon, by ABB.
 - e. Cantex, Inc.
 - f. O-Z/Gedney; a brand of EGS Electrical Group.
 - g. Prime Conduit, Inc.
 - h. RACO; a Hubbell Company.
 - i. Republic Conduit.
 - j. Southwire Company
 - k. Thomas & Betts Corporation.
 - l. Western Tube and Conduit Corporation.
 - m. Wheatland Tube Company; a division of John Maneely Company.

B. METAL WIREWAYS AND AUXILIARY GUTTERS:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-Bid approved equal:
 - a. Cooper B-Line, Inc.
 - b. Eaton Corporation; Cutler-Hammer Products.
 - c. Hoffman; a Pentair company.
 - d. Mono-Systems, Inc.
 - e. Square D; a brand of Schneider Electric.

C. SURFACE RACEWAYS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-Bid approved equal:
 - a. Hubbell Incorporated.
 - b. MonoSystems, Ins.
 - c. Wiremold/ Legrand.

D. BOXES, ENCLOSURES AND CABINETS:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-Bid approved equal:
 - a. Appleton Electric.
 - b. Allied Moulded.
 - c. Carlon, by ABB.
 - d. Cooper Technologies Company; Cooper Crouse-Hinds.
 - e. Eaton Corporation; Cutler-Hammer Products.
 - f. EGS/Appleton Electric.
 - g. Hoffman; a Pentair company.
 - h. Killark; a Hubbell Company
 - i. Milbank Manufacturing Co.
 - j. Mono-Systems, Inc.
 - k. O-Z/Gedney; a brand of EGS Electrical Group.

- I. RACO; a Hubbell Company.
 - m. Square D; a brand of Schneider Electric.
 - n. Thomas & Betts Corporation, ABB Installation Products.
 - o. Wiremold / Legrand.
- E. DUCT ACCESSORIES:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-Bid approved equal:
 - a. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - b. Cantex, Inc.
 - c. Carlon, by ABB
 - d. Kraloy Fittings.
- F. PRECAST CONCRETE HANDHOLES AND BOXES:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. H2 Pre-Cast Inc.
 - b. Oldcastle Infrastructure.
- G. POLYMER CONCRETE AND FIBERGLASS HANDHOLES AND BOXES:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or a pre-Bid approved equal:
 - a. MacLean Highline.
 - b. Oldcastle Infrastructure.
 - c. Quazite; Hubbell Incorporate.

2.2 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. GRC: Comply with ANSI C80.1 and UL 6.
 - 3. ARC: Comply with ANSI C80.5 and UL 6A.
 - 4. IMC: Comply with ANSI C80.6 and UL 1242.
 - 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch (1 mm), minimum.
 - 6. EMT: Comply with ANSI C80.3 and UL 797.
 - 7. FMC: Comply with UL 1; zinc-coated steel.
 - 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
 - 1. Comply with NEMA FB 1 and UL 514B.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 5. Fittings for EMT:
 - a. Material: Steel or die cast.

- b. Type: Setscrew.
 - 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.3 NONMETALLIC CONDUITS AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. All infrastructure for Utilities (power and telecom) are to be provided and installed per the requirements of each Utility.
- C. Nonmetallic Conduit:
- 1. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.
 - 2. ENT: Comply with NEMA TC 13 and UL 1653.
 - 3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated or required by utility service provider.
 - 4. LFNC: Comply with UL 1660.
 - 5. Rigid HDPE: Comply with UL 651A.
 - 6. Continuous HDPE: Comply with UL 651A.
 - 7. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
 - 8. RTRC: Comply with UL 2515A and NEMA TC 14.
- D. Nonmetallic Fittings:
- 1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
 - 3. Solvents and Adhesives: As recommended by conduit manufacturer.
- E. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.4 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.5 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated or required by Code, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be Type 3R and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Screw-cover type unless otherwise indicated or required by Code.
- D. Finish: Manufacturer's standard enamel finish.

2.6 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes:
 1. Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: As required for installation of intended device.
- L. Gangable boxes are allowed.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, **Type 1** with continuous-hinge cover with flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
 3. Where accessible by the residents and/ or the general public, provide tamper resistant hardware.
- N. Cabinets:
 1. NEMA 250, **Type 1** galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 7. Where accessible by the residents and/ or the general public, provide tamper resistant hardware.

2.8 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Comply with ASTM C858 for design and manufacturing processes.
- C. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- D. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- E. Cover Legend: Molded lettering, "ELECTRIC."
- F. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
- G. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - 1. Extension shall provide increased depth as required by utility service provider.
 - 2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
- H. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
 - 1. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - 2. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 - 4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - 5. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.
- I. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.9 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray or Green as per Architect.
- D. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "ELECTRIC."
- H. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.10 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with covers made of hot-dip galvanized-steel diamond plate.
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray or Green as per Architect.
- D. First option in "Configuration" Paragraph below facilitates bottom duct entry. Second option may be provided by a separate slab placed in the excavation under an open-bottom enclosure; third option is obtained by molding or fabricating the bottom integrally with the body of the unit.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC" or "TELECOM" as applicable.
- I. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.11 UTILITY STRUCTURE ACCESSORIES

- A. Test and inspect precast concrete utility structures according to ASTM C1037.
- B. Provide and install per Utility requirements.

- C. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of man-holes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 2. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC unless otherwise required by utility service provider.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew, steel or cast-metal fittings. Compression style fitting are not allowed. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Cables More Than 600 V: Type EPC-40-PVC RNC, installed per Electrical Utility Company requirements.
- B. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- D. Bored Underground Duct: Type EPEC-80-HDPE unless otherwise indicated.
- E. Underground Ducts Crossing Driveways and Roadways: Type EPC-40 PVC RNC, encased in reinforced concrete.
- F. Underground Ducts Crossing Driveways and Roadways: Per Utility requirements.
- G. Stub-ups: Galvanized rigid steel unless required otherwise by the Utility.
- H. Bends: Galvanized rigid steel unless required otherwise by the Utility.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Non-Utility Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
 - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
 - 5. Cover design load shall not exceed the design load of the handhole or box.
 - 6. Provide tamper resistant hardware.

3.4 ABOVE GROUND RACEWAY INSTALLATION

- A. Comply with requirements in Section 260500 "Common Work Results for Electrical" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC before rising above floor unless otherwise required by Code.
- M. Stub-Ups to Above Recessed Ceilings:
 - 1. Use EMT for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Z. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

- BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.
- CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.5 IDENTIFICATION

- A. Identify each spare conduit at each end with specific use (Future EV charging eqpt, Future PV system, Future TI Space, etc) and location of other end of conduit, and identify as spare conduit.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.8 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.9 UNDERGROUND DUCTS AND RACEWAYS PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features

as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

- B. Coordinate elevations of duct and duct-bank entrances into manholes, hand-holes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for re-application according to Section 311000 "Site Clearing."

3.10 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete; confirm requirements with General Contractor.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.11 DUCT AND DUCT-BANK INSTALLATION

- A. Install duct, spacers, and accessories into the duct-bank configuration per Code and/ or Utility requirements. Duct installation requirements in this Section also apply to duct bank.
- B. For electrical-power duct bank, note that ampacity of cables may be reduced in duct bank of more than two tiers of two ducts each.
- C. Install duct according to NEMA TCB 2.
- D. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and hand-holes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- E. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200

mm) for utility service ducts, both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of three 90-degree bends or the total of all bends shall be no more 270 degrees between pull points.
- F. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Hand-holes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.
 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch (19 mm).
 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Hand-holes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to terminator spacing 10 feet (3 m) from the terminator, without reducing duct line slope and without forming a trap in the line.
 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch (19 mm).
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition.
- J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- K. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.
- L. Direct-Buried Duct and Duct Bank:
1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
 2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
 3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.

4. Depth: Install top of duct at least 36 inches (900 mm) below finished grade unless otherwise indicated.
 5. Set elevation of bottom of duct bank below frost line.
 6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 7. Spacer Installation: Install spacers per Utility Service Provider requirements. Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 8. Maintain clearances required by utility service providers.
 9. Elbows: Provide and install per requirements of utility service providers.
 10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
- M. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all duct banks and approximately 12 inches (300 mm) below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.12 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C891 unless otherwise indicated.
 2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
1. Install handholes with bottom below frost line.
 2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

- 3. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required by the utility service providers
- D. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.13 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below frost line.
- E. First paragraph below requires Contractor to select hardware to install and support cable. If required, revise paragraph to refer Contractor to Drawings, and indicate on Drawings specific requirements for each enclosure.
- F. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- G. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.14 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.15 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.

2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.16 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
 1. Sweep floor, removing dirt and debris.
 2. Remove foreign material.

END OF SECTION 260533

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Delegated-Design Submittal: For fault-current/ short-circuit and arc-flash hazard studies.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2 as applicable.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260573 "Electrical Systems Studies" requirements for arc-flash warning labels.

- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and circuits.
- B. Color-Coding for Phase-and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - 1. Color shall be factory applied[or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit].
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral: White or gray.
 - 6. Color for Equipment Grounds: Bare copper, Green or Green with a yellow stripe.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Per Electrical Utility Company requirements.
- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Bond Reference Warning: "'BOND REFERENCE FOR PORTABLE GENERATOR IS THE PERMANENTLY-INSTALLED GENERATOR BOND. DO NOT DISCONNECT PERMANENT GENERATOR OR NEUTRAL BOND AT PERMANENT GENERATOR."
 - 3. Workspace Clearance Warning: "WARNING – CODE REQUIREMENT - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42 INCHES (915 MM)."
- F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-Bid approved equal:
 1. Brady Corporation.
 2. Hellermann Tyton.
 3. Marking Services, Inc.
 4. Panduit Corp.
 5. Seton Identification Products.
- B. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- C. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- D. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- E. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-Bid approved equal:
 1. Brady Corporation.
 2. Hellermann Tyton.
 3. Marking Services, Inc.
 4. Panduit Corp.
- B. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full

shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-Bid approved equal:
 - 1. Carlton Industries, LP.
 - 2. Hellermann Tyton.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
 - 5. Seton Identification Products.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- D. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - 3. Feeder and Branch Circuits 600V and Less:
 - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with "Electric" compounded for direct-burial service.
 - b. Width: 3 inches (75 mm).
 - c. Overall Thickness: 5 mils (0.125 mm).
 - d. Foil Core Thickness: 0.35 mil (0.00889 mm).
 - e. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).

- f. Tensile according to ASTM D882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).
 - 4. Electrical Utility Service Warning Tape:
 - a. Provide as per utility service requirements.
 - b. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - c. Width: 3 inches (75 mm).
 - d. Overall Thickness: 8 mils (0.2 mm).
 - e. Foil Core Thickness: 0.35 mil (0.00889 mm).
 - f. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
 - g. Tensile according to ASTM D882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-Bid approved equal:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
 - 5. Seton Identification Products.
- B. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
- C. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
- D. Write-on Tags:
 - 1. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
 - 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer. Writing on tag must be clearly legible.

2.7 SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-Bid approved equal:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Champion America.
 - 4. Emedco.
 - 5. Marking Services, Inc.

- B. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inches (180 by 250 mm).
- C. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inches (250 by 360 mm).
- D. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with black letters on white face for instructional signs, white letters on a dark gray or black background for identification signs.
 - d. Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-Bid approved equal:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Champion America.
 - 4. Emedco.
 - 5. Marking Services, Inc.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Per utility service provider requirements.

- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer; including the automatic transfer switch, permanent generator, portable generator docking station, and UPS equipment.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- M. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are

made. Apply last two turns of tape with no tension to prevent possible unwinding.

- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
 - 2. Install underground-line warning tape for cables in raceways.
- W. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using General purpose cable ties except where Code requires plenum rated cable ties.
- X. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using General purpose cable ties except where Code requires plenum rated cable ties.
- Y. Write-on Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using General purpose cable ties except where Code requires plenum rated cable ties.
- Z. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- AA. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- BB. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- CC. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

- DD. Cable ties are not to be used to secure conduits or cabling of the electrical or low voltage systems.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wrap-around labels, snap-around color-coding bands or self-adhesive vinyl tape] to identify the phases.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels, Baked-enamel warning signs or Metal-backed, butyrate warning signs.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
 - c. Dispatch Room Consoles.
 - d. Mechanical equipment served by multiple circuit connections.
- M. Arc Flash Warning Labeling: Self-adhesive labels.
- N. Operating Instruction Signs: [Self-adhesive labels] [Baked-enamel warning signs] [Metal-backed, butyrate warning signs] [Laminated acrylic or melamine plastic signs].
- O. Emergency Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed, butyrate warning signs or Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at:
 - 1. Equipment used for power transfer.
 - 2. Portable generator docking station.
 - 3. Permanent generator.
 - 4. UPS equipment.
- P. Equipment Identification Labels:
 - 1. Indoor Equipment: Baked-enamel signs or Laminated acrylic or melamine plastic signs.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Distribution boards.
 - f. Current Transformer enclosure.
 - g. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - h. Emergency system boxes and enclosures.
 - i. Enclosed switches.
 - j. Enclosed circuit breakers.

- k. Enclosed controllers.
- l. Variable-speed controllers.
- m. Push-button stations.
- n. Power-transfer equipment.
- o. Contactors.
- p. Remote-controlled switches and control devices.
- q. Battery-inverter units.
- r. Lighting control system relays, power packs, etc.
- s. Lighting control system wall stations where called out on drawings.
- t. Luminaire remote transformers, drivers, etc.
- u. Monitoring and control equipment.
- v. UPS equipment.
- w. Permanent Generator.
- x. Portable Generator Docking Station.

END OF SECTION 260553

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy and vacancy sensors.
 - 2. Daylight Harvesting Dimming Controls
 - 3. Digital timer light switches.
 - 4. Lighting contactors.
 - 5. Emergency shunt relays.
 - 6. Lighting Control Panel.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Faulty operation of lighting control software.
- b. Faulty operation of lighting control devices.
2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All lighting control equipment and devices are to be hard-wired. Wireless devices are not allowed on the project.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-approved equal:
 1. Acuity Lighting.
 2. Eaton Lighting.
 3. Leviton Mfg. Company, Inc.
 4. Lutron.
 5. Sensorworx.
 6. Wattstopper.
- B. General Requirements for Sensors:
 1. See lighting plans for mountings and types (low voltage, line voltage).
 2. Dual technology.
 3. Hardwired connection.
 4. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Dual-Technology Type: Detect occupants in coverage area using PIR and ultra-sonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 48 inches (1200 mm) above finished floor.

2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-approved equal:
 - 1. Acuity Lighting.
 - 2. Eaton Lighting.
 - 3. Leviton Mfg. Company, Inc.
 - 4. Lutron.
 - 5. Sensorworx.
 - 6. Wattstopper.
- B. General Requirements for Sensors:
 - 1. See lighting plans for mountings.
 - 2. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed. Lights shall dim to off if adequate daylight is present in the space.
 - 3. Hardwired connection.
 - 4. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 5. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

2.4 TIMER LIGHT SWITCH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-approved equal:
 - 1. Acuity Lighting.
 - 2. Eaton Lighting.
 - 3. Intermatic.
 - 4. Leviton Mfg. Company, Inc.
 - 5. Lutron.
 - 6. Sensorworx.
 - 7. Wattstopper.
- B. Description: Combination timer and conventional switch lighting control unit. Switchbox-mounted with selectable time interval in 10 minute increments.
 - 1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for LED, and 1/4 horsepower at 120-V ac.
 - 2. Integral relay for connection to BAS.
 - 3. Voltage: Match the circuit voltage.
 - 4. Color: Per Architect
 - 5. Faceplate: Color matched to switch.

2.5 EMERGENCY SHUNT RELAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-approved equal:

1. Acuity Lighting.
2. Eaton Lighting.
3. Leviton Mfg. Company, Inc.
4. Lutron.
5. Sensorworx.
6. Wattstopper.

B. Description: Complying with UL 924.

2.6 LIGHTING CONTROL PANEL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-approved equal:
1. Acuity Lighting.
 2. Cooper Lighting Controls.
 3. Lutron.
 4. Wattstopper
- B. Lighting control panel shall be UL 924 Listed as required for control of emergency lighting circuits.
- C. The lighting control panel shall be able to be barriered into multiple sections; see lighting control panel schedule in the design drawings.
- D. See lighting plans for additional information and requirements.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No.18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections. Replace all defective lighting control devices and retest.
- C. Prepare test and inspection reports.

3.7 COMMISSIONING

- A. After the factory-authorized service representative has completed start-up for all of the lighting control devices and systems, the Contractor shall arrange for the factory-authorized service representative to test the system with the Commissioning Agent.
- B. The Contractor shall provide completed start-up forms and checklists to the Engineer and Commissioning Agent for all lighting and receptacle control systems and equipment.
- C. The Contractor shall coordinate with the Owner, Architect and General Contractor; tests should be performed in the presence of the Owner, Commissioning Agent and Architect unless given specific permission otherwise in writing.
- D. The factory-authorized service representative shall coordinate the commissioning of the lighting and receptacle controls with the Commissioning Agent per the Commissioning Plan. This shall include functional testing of:
 - 1. All daylighting controls.
 - 2. All occupancy and vacancy sensor.
 - 3. All manual controls.
 - 4. The lighting control panel scheduled dimming of corridor luminaires at night as indicated in the design documents, including manual override controls.
 - 5. All exterior lighting controls; dusk to dawn and dusk to curfew fixtures.
 - 6. Receptacle controls.
- E. It is the responsibility of the Contractor and factory-authorized service representative to re-adjust or replace all equipment and devices that are not operating within the require parameters.
- F. The Commissioning Agent will generate a Commissioning report summarizing the Commissioning process. The Contractor shall assist and provide documentation as required to complete this report.

3.8 ADJUSTING

- A. Light Level Setting: The Contractor and factory-authorized service representative shall schedule with the Architect and Engineer a time to review and adjust the settings of initial luminaire output levels of the Entry Vestibule 101A, the exterior wall grazers (Type W8) and the exterior uplights at the east entry (Type W9). Review of the exterior luminaires shall occur after sunset.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices and the lighting and receptacle control systems.
- B. The factory-authorized service representative shall provide at least 3 hours of training for the Owner's maintenance personnel.

END OF SECTION 260923

SECTION 26 24 13

PANELBOARDS AND TERMINATION CABINETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Termination Cabinet.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard and panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard, panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.

2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of switchboards, panelboards and overcurrent protective devices.
6. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
7. Detail utility company's metering provisions with indication of approval by utility company.
8. Include evidence of NRTL listing for series rating of installed devices.
9. Include evidence of NRTL listing for SPD as installed in panelboard.
10. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
11. Include wiring diagrams for power, signal, and control wiring.
12. Key interlock scheme drawing and sequence of operations.
13. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

C. DELEGATED DESIGN SUBMITTALS

1. For available fault current / short circuit calculations, overcurrent protection devices coordination study, and arc-flash hazard analysis.
2. For arc-flash labels.

1.5 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards.
- B. Seismic Qualification Data: Certificates, for switchboards, panelboards, overcurrent protective devices, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Testing Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards, panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Manufacturer Qualifications: ISO 9001 or 9002 certified.
- C. Testing Agency Qualifications: Accredited by NETA.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and panelboards; install temporary electric heating (250 W per switchboard section or panelboard) to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400.
- D. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards or panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).

1.11 COORDINATION

- A. Coordinate layout and installation of switchboards, panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory in-

stalled interconnection wiring that fail in materials or workmanship within specified warranty period:

1. Warranty Period: Three years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- C. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARD COMMON REQUIREMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Electric by ABB.
 2. Eaton Corporation; Cutler-Hammer Products.
 3. Siemens Energy & Automation, Inc.
 4. Square D.
- B. Source Limitations: Obtain switchboards, panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards and panelboards including clearances between equipment and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.
- F. Nominal System Voltage: See single-line diagrams.
- G. Equipment ratings: See single-line diagrams.

2.2 PANELBOARD REQUIREMENTS

- A. Comply with NEMA PB 2.
- B. Comply with UL 891.
- C. Seismic Requirements: Fabricate and test panelboards according to IEEE 344 to withstand seismic forces as required by Code, AHJ and project Structural Engineer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- D. Indoor Enclosures: Steel, NEMA 250, Type 1.
- E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- F. Service Entrance Rating: Panelboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with over-current protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
 - 1. NRTL Label: Where indicated on the single-line diagram as service entrance rated, equipment shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices.
- G. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 - 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 3. Tin-plated aluminum feeder circuit-breaker line connections.
 - 4. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 - 5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

6. Disconnect Links:
 - a. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- H. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- I. Short-Circuit Current Rating for Normal Power equipment: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 1. Panelboards rated 240 V or less shall have short-circuit ratings as required by the Contractor's Short Circuit Study, but not less than 10,000 A rms symmetrical.
 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as required by the Contractor's Short Circuit Study, but not less than 14,000 A rms symmetrical.
- J. Short-Circuit Current Rating for Normal Power equipment: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as required by the Contractor's Short Circuit Study, but not less than 10,000 A rms symmetrical.
 2. Switchboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as required by the Contractor's Short Circuit Study or 14,000 A rms symmetrical, whichever is greater.
- K. SURGE PROTECTION DEVICES
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. General Electric by ABB.
 - b. Eaton Corporation; Cutler-Hammer Products.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D.
 2. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.
 3. Features and Accessories:

- a. Integral disconnect switch.
 - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - c. Indicator light display for protection status.
4. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
5. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - a. Line to Neutral: 700 V for 208Y/120 V.
 - b. Line to Ground: 1200 V for 208Y/120 V.
 - c. Line to Line: 1000 V for 208Y/120 V.
6. SCCR: Equal or exceed 100 kA.
7. Nominal Discharge Current Rating: 20 kA.

2.3 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined as required by Code, AHJ and project Structural Engineer.
- B. Comply with NEMA PB 1.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Enclosures: Enclosures: Flush and Surface-mounted as noted on drawings, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. Height: 84 inches (2.13 m) maximum.
 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 5. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.

- E. Incoming Mains:
 - 1. Location: Per Contractor.
 - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- F. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- G. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. NRTL Label: Where indicated on the single-line diagram as service entrance rated, equipment shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices.
- I. Short-Circuit Current Rating: Series rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 - 1. Panelboards/ load centers and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as required by the Contractor's Short Circuit Study or 10,000 A rms symmetrical, whichever is greater.
 - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as required by the Contractor's Short Circuit Study or 14,000 A rms symmetrical, whichever is greater.

2.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards, Panelboards and load centers shall withstand the effects of earthquake motions determined according to local AHJ requirements and the Project Structural Engineer.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will remain operational."

2.5 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- C. Mains: Circuit breaker or Lugs only as indicated on drawings.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or Lugs only as indicated on drawings.
- C. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.7 LOAD CENTERS

- A. Load Centers: Comply with UL 67.
- B. Mains: Circuit breaker or Lugs only as indicated on drawings.
- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

- D. Doors: Concealed hinges secured with flush latch.
- E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.8 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and $I^2 T$ response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Panelboard Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - f. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - h. Shunt Trip: 120-V trip coil energized from separate circuit.
- B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
 1. Two-step, stored-energy closing.
 2. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Time adjustments for long- and short-time pickup.
 - c. Ground-fault pickup level, time delay, and I^2t response.
 3. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 4. Remote trip indication and control.

- C. Fused Switch (only where shown on Contract Drawings set): NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.9 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.10 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260500, "Common Work Results for Electrical," or manufacturer's instructions.

2.11 TERMINATION CABINET REQUIREMENTS

- A. Termination Cabinet to meet requirements of Seattle City Light (SCL), including but not limited to SCL Standard 0230.03.
- B. Manufacturer: Subject to SCL requirements, provide equipment by Skyline Electric & MFG Co or a pre-approved equal accepted by SCL. Contractor to provide proof of SCL acceptance with substitution request form.
- C. General Requirements for Termination Cabinet:
 - 1. UL Listed, NEMA 3R pad-mounted cabinet with lockable doors.
 - 2. Conform to all SCL requirements.
 - 3. Bus bars to be located at tops of cabinet, drilled per SCL Standard 0474.08 and run from front to back.
 - 4. No mullion to be provided between the doors. The doors shall meet up when shut, shut that they are lockable with only one utility padlock.
 - 5. See Contract Drawings for additional information and requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 400 and NECA 407.
 - 1. Lift or move with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
- C. Protect from moisture, dust, dirt, and debris during storage and installation.
- D. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- E. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Install termination cabinet and accessories per SCL Requirements and Manufacturer's Instructions.
- E. Equipment Mounting - Panelboards:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 2. Comply with requirements for seismic control devices as required by the local AHJ and Project Structural Engineer.
- F. Equipment Mounting – Termination Cabinet: Install termination cabinet on a concrete base per SCL requirements. Anchor per Manufacturer Instructions and SCL requirements.

- G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from equipment.
- H. Comply with mounting and anchoring requirements as required by the local AHJ and Project Structural Engineer.
- I. Mount such that the top-most circuit breaker is not higher than 79-inches above finished floor as required by Code.
- J. Mount panelboard cabinet plumb and rigid without distortion of box.
- K. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.
- L. Install overcurrent protective devices, controllers and instrumentation not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- M. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- N. Install filler plates in unused spaces.
- O. Install filler plates in unused spaces of panel-mounted sections.

3.3 CONNECTIONS

- A. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more service disconnecting and overcurrent protective devices.
- B. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Create a directory to indicate installed Panelboard circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Panelboards:
 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Coordinate tests and inspections of the Termination Cabinet with SCL.
- D. Panelboards and the Termination Cabinet will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain panelboards, switchboards, termination cabinet, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

SECTION 262713
ELECTRICITY METERING

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 utility electricity metering.

1.3 DEFINITIONS

- A. KY or KYZ Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity (kWh) that is based on a relay opening and closing in response to the rotation of the disk in the meter. Electronic meters generate pulses electronically.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of meter.
 - 2. For metering infrastructure components.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Include elevation views of front panels of control and indicating devices and control stations.
 - 2. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Meter data sheet for each meter.

1.6 COORDINATION

- A. Electrical Service Connections:
 - 1. Coordinate with utility companies and utility-furnished components.
 - a. Comply with requirements of utility providing electrical power services.
 - b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric by ABB EPIS.
 - 2. Eaton Corporation; Cutler-Hammer Products.
 - 3. Milbank Manufacturing.
 - 4. Siemens Energy & Automation, Inc.
 - 5. Square D; a brand of Schneider Electric USA, Inc.
- B. Provide and install utility metering infrastructure per the requirements of the utility company.
- C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets:
 - 1. Comply with requirements of electrical-power utility company.
 - 2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
 - 3. Meter Socket Rating: Coordinated with connected feeder circuit rating.
- E. Arc-Flash Warning Labels;
 - 1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 260573 "Electrical Systems Studies." Apply a 3-1/2-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install raceways, meter socket, CT cabinets and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install arc-flash labels as required by NFPA 70.
- D. Wiring Method:
 - 1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Minimum conduit size shall be 1/2 inch (13 mm) unless larger size required by utility company.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Coordinate with utility company to perform tests and inspections.
- B. For non-utility meters, Contractor to Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Equipment and Software Setup:
 - a. Set meter date and time clock.
 - b. Test, calibrate, and connect pulse metering system.
 - c. Set and verify reporting demand interval for demand meters.
 - d. Report settings and calibration results.
 - e. Set up reporting software.
 - 2. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 3. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 4. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
 - 6. Generate test report for each tenant or activity from the meter reading tests.

- D. Electricity metering will be considered defective if it does not pass tests and inspections.

END OF SECTION 262713

SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. GFCI receptacles, 125 V, 20 A.
 - 3. Tamper-resistant standard-grade receptacles, 125 V, 20A.
 - 4. Tamper-resistant GFCI receptacles, 125 V, 20A.
 - 5. USB Charging Receptacles, 125 V, 20 A.
 - 6. Twist-locking receptacles.
 - 7. Pendant cord-connector devices.
 - 8. Toggle switches, 120/277 V, 20 A.
 - 9. Decorator-style devices, 125 V, 20A.
 - 10. Occupancy sensors.
 - 11. Wall plates.
 - 12. Floor service fittings.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Manufacturers: Subject to compliance with requirements, for the following Sections provide products from one of the following:
 - 1. Cooper Wiring Devices: Division of Cooper Industries, Inc.
 - 2. Hubbell Incorporated.
 - 3. Legrand North America, LLC.
 - 4. Leviton Mfg. Company, Inc.
 - 5. Pass & Seymour; Legrand North America, LLC.
- B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Comply with NFPA 70.
- D. RoHS compliant.
- E. Comply with NEMA WD 1.
- F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with requirements in this Section.
- G. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- H. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to UPS System: Gray or as selected by Architect.
- I. Wall Plate Color: For plastic covers, as selected by Architect.
- J. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL PURPOSE RECEPTACLES, INTERIOR LOCATIONS:

- A. In Common areas of multifamily buildings, provide 125V, 20A, Tamper-Resistant receptacles unless otherwise required by Code, equipment to be connected, or the Contract Documents. Provide GFCI type receptacles or GFCI type breakers where GFCI protection is required; see Contract Drawings.
- B. In MEP equipment rooms and other areas of multifamily buildings not accessible to residents, provide 125V, 20A receptacles unless otherwise required by Code, equipment to be connected, or the Contract Documents. Provide GFCI type receptacles or GFCI type breakers where GFCI protection is required; see Contract Drawings.
- C. Provide 125V, 20A, receptacles unless otherwise required by Code, equipment to be connected, or the Contract Documents. Provide GFCI type receptacles or GFCI type breakers where GFCI protection is required; see Contract Drawings.
- D. See Contract Drawings for requirements and locations for controlled receptacles.
- E. Provide specialty type receptacles as required for appliances/ equipment and/ or as indicated on the drawings.

2.3 GENERAL PURPOSE RECEPTACLES, EXTERIOR LOCATIONS:

- A. For all exterior areas provide 125V, 20A, Tamper-Resistant, weather resistant, GFCI-type receptacles in weatherproof while in use enclosures unless otherwise required by Code, equipment to be connected, or the Contract Documents.
- B. Provide specialty type receptacles as required for appliances/ equipment and/ or as indicated on the drawings.

2.4 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A
 - 1. Description: Two pole, three wire, and self-grounding.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498.
- B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A
 - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498.
 - 4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.5 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A
 - 1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Type: Non-feed through.
 4. Standards: Comply with UL 498, UL 943 Class A.
- B. Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Square face.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Type: Non-feed through.
 4. Standards: Comply with UL 498 and UL 943 Class A.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.
- C. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20A
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Type: Feed through as allowed by Code and project requirements.
 4. Standards: Comply with UL 498, UL 943 Class A.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- D. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20A
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Type: Non-feed through.
 4. Standards: Comply with UL 498 and UL 943 Class A.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.6 USB RECEPTACLES

- A. USB Charging Receptacles
1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 2. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
 3. Standards: Comply with UL 1310 and USB 3.0 devices.
 4. Provide receptacles listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" where noted on drawings.

2.7 TWIST-LOCKING RECEPTACLES

- A. Configuration: NEMA WD 6, See Power Plans for Configuration.
- B. Standards: Comply with UL 498.

2.8 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.
- B. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.
- C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
- E. Standards: Comply with FS W-C-596.

2.9 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A
 - 1. Standards: Comply with UL 20.
- B. Two-Pole Switches, 120/277 V, 20 A
 - 1. Comply with UL 20.
- C. Three-Way Switches, 120/277 V, 20 A
 - 1. Comply with UL 20.
- D. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A
 - 1. Description: Illuminated when switch is off.
 - 2. Standards: Comply with UL 20.
- E. Lighted Single-Pole Switches, 120/277 V, 20 A
 - 1. Description: Handle illuminated when switch is off.
 - 2. Standards: Comply with NEMA WD 1, UL 20.

- F. Key-Operated, Single-Pole Switches, 120/277 V, 20 A
 - 1. Description: Factory-supplied key in lieu of switch handle.
 - 2. Standards: Comply with UL 20.
- G. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A
 - 1. Description: For use with mechanically held lighting contactors.
 - 2. Standards: Comply with NEMA WD 1, UL 20.
- H. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A
 - 1. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 - 2. Standards: Comply with NEMA WD 1, UL 20.

2.11 OCCUPANCY SENSORS

- A. Wall Switch Sensor Light Switch, Dual Technology
 - 1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
 - 2. Standards: Comply with UL 20.
 - 3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 - 4. Adjustable time delay of 15 or 30 minutes as indicated on drawings.
 - 5. Able to be set to Automatic or Manual-On mode as indicated on drawings.
 - 6. Connections: Hard wired.

2.12 TIMER LIGHT SWITCH

- A. Digital Timer Light Switch
 - 1. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10-minute increments.
 - 2. Standards: Comply with UL 20.
 - 3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 - 4. Integral relay for connection to BAS.

2.13 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.14 FLOOR SERVICE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, for the following Sections provide products from one of the following:
 - 1. Hubbell Incorporated.
 - 2. Wiremold; Legrand North America, LLC.
- B. See drawings for additional information and requirements.
- C. Flap-Type Floor Service Fittings:
 - 1. Description: Type: Modular, flap-type, dual-service units suitable for wiring method used, with flaps flush with finished floor. Receptacles and data outlets to be installed in floor box below floor level and accessed through flaps (i.e. receptacles and outlets are not to be installed flush with floor facing up).
 - 2. Provide boxes rated for slab on grade installation where required.
 - 3. Compartments: Barrier separates power from voice and data communication cabling.
 - 4. Flaps: Rectangular, die-cast aluminum with satin finish.
 - 5. Service Plate: Same finish as flaps.
 - 6. Power Receptacle: NEMA WD 6 Configuration 5-20R, colors to be project standards (normal, UPS receptacles to be different colors per Architect), unless otherwise indicated.
 - 7. Data Communication Outlet: See preliminary low voltage systems drawings and confirm with Design-Build Low Voltage Contractor, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.15 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.
- B. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: [Metal, with manufacturer's standard finish] [PVC].
- D. Multioutlet Harness:
 - 1. Receptacles: 20-A, 125-V, NEMA WD 6 Configuration 5-20R receptacles complying with NEMA WD 1, UL 498.
 - 2. Receptacle Spacing: 6 inches (150 mm).
 - 3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

- B. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the race-way system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
 5. Coordinate wall-mounted occupancy sensor switches with door swings; do not locate such that they will be blocked by open doors.
- C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
 1. device, listing conditions in the written instructions.
- G. Dimmers:
 1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan-speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles; all receptacles requiring GFCI protection are to be GFCI-type (i.e. protection of downstream receptacles via feed through of upstream GFCI devices is not allowed).

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. In the Equipment Room, identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Perform the following tests and inspections:
- C. Tests for Receptacles:
 1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 20-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.

- 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections. Contractor to replace all defective wiring devices and retest.

3.5 COMMISSIONING

- A. After the factory-authorized service representative has completed start-up for all of the lighting and receptacle control devices and systems, the Contractor shall arrange for the factory-authorized service representative to test the system with the Commissioning Agent.
- B. The Contractor shall provide completed start-up forms and checklists to the Engineer and Commissioning Agent for all lighting and receptacle control systems and equipment.
- C. The Contractor shall coordinate with the Owner, Architect and General Contractor; tests should be performed in the presence of the Owner, Commissioning Agent and Architect unless given specific permission otherwise in writing.
- D. The factory-authorized service representative shall coordinate the commissioning of the lighting and receptacle controls with the Commissioning Agent per the Commissioning Plan. This shall include functional testing of:
 - 1. All daylighting controls.
 - 2. All occupancy and vacancy sensor.
 - 3. All manual controls.
 - 4. The lighting control panel scheduled dimming of corridor luminaires at night as indicated in the design documents, including manual override controls.
 - 5. All exterior lighting controls; dusk to dawn and dusk to curfew fixtures.
 - 6. Receptacle controls.
- E. It is the responsibility of the Contractor and factory-authorized service representative to re-adjust or replace all equipment and devices that are not operating within the require parameters.
- F. The Commissioning Agent will generate a Commissioning report summarizing the Commissioning process. The Contractor shall assist and provide documentation as required to complete this report.

END OF SECTION 262726

SECTION 26 28 13

FUSES AND ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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. Fusible switches.
 - 2. Cartridge Fuses.
 - 3. Nonfusible switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to Code.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories: Provide accessories as required for specific installation/usage.

2.4 CARTRIDGE FUSES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
- B. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.5 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories: Provide accessories as required for specific installation/usage.

2.6 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

- F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- G. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- H. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- J. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- K. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- L. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- M. Features and Accessories: Provide features/accessories as required for specific installation/usage. Including but not limited to:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 6. Electrical Operator: Provide remote control for on, off, and reset operations.

2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than fifteen working days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Verify correct phase barrier installation.
 - h. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
- C. Tests and Inspections for Molded Case Circuit Breakers:
 - 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.
- C. Adjust relay and protective device settings according to recommended settings provided by the coordination study (see Specification Section 26 05 73). Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.

END OF SECTION 262816

SECTION 263100

PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 01 - General Requirements for all work in Division 26.

1.02 SUMMARY

- A. **This is a design/build specification.** Contract Documents are meant to provide information (scope, performance requirements, preliminary quantities and locations, etc) for Bidding by Design-Build Photovoltaic Contractors only. All final quantities and locations of equipment and devices shall be coordinated with the Fire Marshal/ Local AHJ (as applicable), Architect and Owner prior to the start of construction.
- B. The Design-Build Contractor shall design, permit, provide and install a complete and fully operational Fire Alarm system that meet all requirements of the Owner, Fire Marshal/ local AHJ and as per the Project Contract Documents.
- C. Design Intent: The project includes a Design-Built Photovoltaic (PV) system for a campus wide substantial renovation to an existing low-income apartment complex consisting of 24 existing apartment buildings owned by King County Housing Authority, located in Kirkland WA. Design-Build Contractor is to coordinate directly with the owner to determine the extent of the PV scope on a building-by-building basis. See Complete Bid Set plans and specifications for additional information.
 - 1. The System shall be sized to meet the requirements of Section C406.5 in the Washington State Energy Code.

1.03 DEFINITIONS

- A. ETFE: Ethylene tetrafluoroethylene.
- B. FEP: Fluorinated ethylene propylene.
- C. IP Code: Required ingress protection to comply with IEC 60529.
- D. MPPT: Maximum power point tracking.
- E. PV: Photovoltaic.
- F. PVUSA: Photovoltaics for Utility Systems Applications.
- G. STC: Standard Test Conditions defined in IEC 61215.

*Supportive Housing***1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product including, but not limited to, PV modules, Inverter(s), support/ rack system, and disconnects.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For PV modules.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.05 DESIGN DRAWINGS

- A. All drawings, specifications and calculations prepared by the PV Design-Build Contractor shall be stamped by an Engineer currently registered in the State of Washington.
- B. The Design-Build Contractors shall submit drawings and diagrams for review and for job coordination:
 - 1. Permit / Construction Drawings for review. These drawings shall be submitted at two milestones as selected by the Architect in electronic PDF format.
 - a. The Contractors' drawings shall match the layout of the Architectural drawings.
 - b. The Drawing Sets shall include at a minimum:
 - 1) Symbols, Legend and drawing list sheets.
 - 2) Equipment Schedules.
 - 3) PV System sheets and calculations approved by the local AHJ.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.

1.07 WARRANTY

- A. Manufacturer's Product Workmanship Warranty: Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.
 - 1. Manufacturer's materials and workmanship warranties include, but are not limited to, the following:
 - a. Faulty operation of PV modules.
 - 2. Warranty Period: Twelve years from date of Substantial Completion.
- B. Manufacturer's Minimum Power Output Warranty: Manufacturer agrees to repair or replace components of PV modules that fail to exhibit the minimum power output within specified warranty period. Special warranty, applying to modules only, applies to materials only, on a prorated basis, for period specified.
 - 1. Manufacturer's power output warranties include, but are not limited to, the following warranty periods, from date of Substantial Completion:
 - a. For the first year from the date of Substantial Completion, every product will have a power output that is at least 97.5 percent or more of the nameplate maximum power output specified for the product.
 - b. From year 2 through year 30, degradation will not exceed 0.7% of the nameplate maximum power output specified for the product, such that at the end of the 30th year, all products will have a power output that is at least 80% of the nameplate maximum power output specified for the product.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. PV Modules
 - 1. Manufacturers: Subject to project requirements, provide PV Modules by silfab solar or pre-Bid approved equal.
 - 2. Solar modules are to be listed per UL 1703.
- B. PV System Inverters
 - 1. Manufacturers: Subject to project requirements, provide PV Modules by Enphase Energy or Solectria pre-Bid approved equal
- C. PV System Mounting Systems

Supportive Housing

1. Manufacturers: Subject to project requirements, provide PV Modules by PanelClaw or pre-Bid approved equal.
2. Supporting System for PV modules to be listed per UL 2703 with Class B fire certification.

2.02 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Hazardous Locations: FM Global approved for NFPA 70, Class 1, Division 2, Group C and Group D.
- C. Seismic Qualification Certificates: For wall or floor mounted inverters where specified, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

2.03 PV SYSTEMS DESCRIPTION

- A. The System shall be sized to meet the requirements of Section C406.5 in the Washington State Energy Code at a minimum. Increasing to a larger array size is only upon direction and approval from the owner.
- B. The PV system shall include PV modules with a structurally fixed system attached to the roof and central-inverter(s).
 1. Provide hard connections to roof where required by Local AHJ.
 2. Locate modules on roof per Code and Fire Marshal requirements. Coordinate locations with Architect and all other trades.
- C. See the electrical single-line diagram and power roof plan for additional information and requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- E. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of PV panels with roof assembly and other construction.
- C. Support PV panel assemblies independent of supports for other elements such as roof and support assemblies, enclosures, vents, pipes, and conduits. Support assembly to prevent twisting from eccentric loading.
- D. Install weatherseal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. See Section 079200 "Joint Sealants" for materials and application.
- E. Seismic Restraints: Comply with requirements for seismic-restraint devices as per the requirements of the local AHJ.
- F. Wiring Method: Install cables in raceways.
 - 1. Pigtail cables between individual PV modules may be installed without conduit as allowed by Code and where they are not exposed to physical damage.
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

Supportive Housing

3.03 CONNECTIONS

- A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.
- B. Coordinate all infrastructure requirements (raceways, boxes, disconnects on the AC side of the system, etc) with the Electrical Contractor.
- C. Coordinate installation of net and production meters with utility and electrical contractor.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

END OF SECTION 263100

SECTION 26 51 19

INTERIOR AND EXTERIOR LIGHTING

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 interior and exterior luminaires, exit signs, emergency lighting units, and emergency lighting inverters.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. For each pole, accessory:
 - a. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
 - b. Include finishes for lighting poles and luminaire-supporting devices.
 - c. Anchor bolts.
 - d. Manufactured pole foundations.
 - 7. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for

lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all luminaires and lamp types used on Project; use ANSI and manufacturers' codes.
 2. Copies of all Manufacturers' Warranties.

1.6 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- B. Store poles on decay-resistant skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- D. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch (6 mm) deep. Do not apply tools to section of pole to be installed below finished grade.

- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.8 WARRANTIES

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires and poles that fail in materials or workmanship within specified warranty period.
- B. LUMINAIRES:
 - 1. Warranty Period: Five year(s) from date of Substantial Completion.
 - 2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion
- C. EMERGENCY LIGHTING INVERTERS
 - 1. Provide 3-year warranty on system electronics and 1 year full, 7-year pro-rata warranty on batteries, minimum.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
 - 1. Luminaires shall withstand the effects of earthquake motions determined according to the requirements of the local AHJ and the Project Structural Engineer.
 - 2. Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7, the requirements of the local AHJ and the Project Structural Engineer.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Structural Characteristics: Comply with AASHTO LTS-6-M.
- D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- E. Live, Ice and Wind Loads: Per the requirements of Code, the local AHJ and the project Structural Engineer.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. See Luminaire Schedule in Contract Drawing Set for Luminaire Requirements for each Luminaire Type, Basis of Design manufacturers, Approved Alternate Manufacturers, etc.

2.3 EMERGENCY LIGHTING INVERTERS:

- A. Manufacturers: Contingent upon compliance with project requirements, provide emergency lighting inverters from one of the below listed manufacturers. Please note, some of these manufacturers will need to provide extended warranties (over their standard) to meet project requirements; see Warranties section above.
 - 1. Bodine by Signify.
 - 2. Chloride by Signify.
 - 3. Dual-Lite.
 - 4. Iota Emergency Lighting, Acuity Brands.
 - 5. Power Sentry, Acuity Brands.
 - 6. Myers Emergency Power Systems.
 - 7. Sure-Lites, Cooper Lighting Solutions.
- B. Provide emergency lighting inverters sized as required to serve emergency luminaires indicated on drawings without integral battery packs. The project is to be served by multiple small emergency lighting inverters, not one large central inverter.
- C. UL 924 listed.
- D. UL 924 self-testing and self-diagnostics.
- E. Emergency lighting inverters are to be compatible with LED luminaires.
- F. Emergency lighting inverters shall provide 90-minute run time.
- G. Input voltage shall be field selectable at 120VAC or 277VAC.
- H. Output voltage distortion shall be less than 10% for resistive loads.
- I. Emergency lighting inverters shall be compatible with generators (10X inverter size).
- J. Emergency lighting inverters shall have maintenance free VRLA batteries and a microprocessor-controlled, 3-stage battery charger.

- K. Alarms shall include monthly test fault, yearly test fault, charger fault, output voltage low, output voltage high, overload fault, low voltage disconnect, heatsink over temp and input fuse failure.
- L. Emergency lighting inverters shall have AIC rating as needed for available fault current as per the Contractor's Short Circuit/ Fault Current calculations.
- M. Inverter operating temperature: 32 degrees F to 104 degrees F (0 degrees C to 40 degrees C).
- N. Battery operating temperature: 68 degrees F to 86 degrees F (20 degrees C to 30 degrees C) per UL 924 specifications.

2.4 POLE REQUIREMENTS

- A. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- B. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- C. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- D. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws

2.5 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 - 1. Manufacturer's standard grade.
 - 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.6 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260500 for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm) or as required by Structural Engineer and local AHJ, whichever is larger.
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Supports:

1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning.
 3. Provide support for luminaire without causing deflection of ceiling or wall.
 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- D. Flush-Mounted Luminaires:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- E. Wall-Mounted Luminaires:
1. Attached to structural members in walls or as per Manufacturer's Instructions and Structural Engineer's requirements.
 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaires:
1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 2. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 POLE AND BOLLARD FOUNDATIONS

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.
1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.
- D. Direct-Buried Foundations: Install to depth required by Structural Engineer. Add backfill as required by Structural Engineer, tamping each layer before adding the

next. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.

1. The Electrical Contractor is to hire a Structural Engineer currently registered in the State of Washington to engineer foundations for light poles and bollards and support structures for power conductors, communications cable tray, communications racks, etc. See Project Drawing set for additional information and requirements.

- E. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.5 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing or required by the Utilities, Code or the AHJ.
 1. Fire Hydrants and Water Piping: 60 inches (1520 mm)
 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet (3 m)
 3. Trees: 15 feet (5 m) from tree trunk
- C. Concrete Pole and Bollard Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles and Bollards: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 3. Install base covers unless otherwise indicated.
 4. Use a short piece of 1/2 -inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole
- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.
- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

- B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.7 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
 - 3. Bond metal poles and bollards to grounding electrode system. See Project Drawing Set.
- B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundation.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
 - 3. Inspect poles for nicks, mars, dents, scratches, and other damage.
- B. Luminaires will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to one visit to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace luminaires that are defective. Adjust luminaires that are no longer level.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION 265119

SECTION 27 00 00

LOW VOLTAGE SYSTEMS GENERAL CONDITIONS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 01 - General Requirements for all work in Division 26.

1.2 SUMMARY

- A. **This is a design/build specification.** Contract Documents are meant to provide information (scope, performance requirements, preliminary quantities and locations, etc) for Bidding by Design-Build Contractors only. All final quantities and locations of equipment and devices shall be coordinated with the Fire Marshal/ Local AHJ (as applicable), Architect and Owner prior to the start of construction.
- B. Design Intent: The project includes Electrical, Fire Alarm and Low Voltage systems for the commercial scope of a campus wide substantial renovation to an existing low-income apartment complex consisting of 24 existing apartment buildings owned by King County Housing Authority, located in Kirkland WA. The Commercial scope includes a new 4,000 square foot Community Building and the new site lighting infrastructure.
- C. All Fire Alarm and Low Voltage Systems are Design-Build; Contract Documents (drawings and specifications) are meant to provide information (scope, performance requirements, preliminary quantities and locations, etc) for Bidding by Design-Build Contractors only.
- D. The Design-Build Contractors shall design, provide and install complete and fully operational and coordinated systems that meet all requirements of the Owner, local AHJ and as per the Project Contract Documents.
 - 1. All voice and data cabling design shall be performed by an RCDD or by a designer with five or more years of experience with telecommunications cabling design. Contractor to provide proof of designer qualifications.
- E. Low Voltage Systems to be provided for the Project include:
 - 1. Fire Alarm System.
 - 2. Telecom Systems.
 - 3. Wireless Network at Community Building.
 - 4. CATV System.
 - 5. CCTV System..
 - 6. Access Control System.
 - 7. Security System (equipment and devices by Others, Low Voltage and Electrical Contractors to pre-wire and provide conduit, boxes, and line voltage power).
 - 8. Audio/ Visual System.

- F. The Contractor shall provide all labor, materials, equipment and devices, supports, etc necessary for satisfactory installation of fire alarm and low voltage work ready to operate in strict accordance with Code requirements and these specifications and drawings including but not limited to all switches, routers, CCTV cameras and NVR server, racks, patch panels, patch cables, 110 blocks, terminations, etc. The Contractor shall also provide permanent labeling at both ends of all low voltage cabling, color coded for each system, which shall match the numbering scheme of the Low Voltage system As-Built drawings for all terminations.
 - 1. The Contractor shall test all terminations to ensure they are in good working order. Any and all faulty cables and/ or terminations shall be replaced at no cost to the Owner.
- G. All final quantities and locations of equipment and devices shall be coordinated with the Fire Marshal/ Local AHJ (as applicable), Architect and Owner prior to the start of construction.
- H. Sustainability Goals: The Project is pursuing Evergreen Sustainable Development Standards (ESDS) Certification. The Contractor shall coordinate with the Architect and General Contractor to ensure compliance with the Prerequisites and intended Credits for the project. See Division 01 Specification and subsequent Division 26, 27 and 28 Specifications for additional information and requirements.
- I. The Contractors shall provide all labor, materials, equipment and devices, supports, etc necessary for satisfactory installation of fire alarm and low voltage work ready to operate in strict accordance with Code requirements and these specifications and drawings.
- J. Related Sections: All Division 01, 26, 27 and 28 Specification Sections included in the Contract Documents.
- K. Commissioning Activities and Submittals: The Project shall be commissioned per Energy Code and ESDS requirements. The Contractor shall coordinate with the General Contractor, Architect and Commissioning Agent and provide support for the complete commissioning process as required. See Divisions 01, 26, 27 and 28 for additional information.

1.3 COORDINATION MEETINGS

- A. The Design-Build Low Voltage Contractor shall coordinate with the Electrical and General Contractor to arrange for two coordination meetings/ conference calls for the low voltage systems for the project. The attendees shall include the Low Voltage Contractor, the Electrical Contractor, the General Contractor, the Owner/ Owner's Rep, the Owner's IT Department, the Architect and the Electrical Engineer.
- B. The first meeting/ conference call shall occur within four (4) weeks of the Contractor receiving notice to proceed on the project and before the Low Voltage Contractor has issued their first set of shop drawings for the Low Voltage systems for the project. The intent of this meeting is for the Low Voltage

Contractor to discuss design intent with the Owner and confirm the requirements for all systems.

- C. The second meeting/ conference call shall occur within two (2) weeks of the Low Voltage Contractor issuing their first set of shop drawings for the Low Voltage systems for the project. The intent of this meeting is for the Low Voltage Contractor to discuss specific equipment and device locations with the Owner and Architect.
 - 1. The Design-Build Low Voltage Contractor shall issue their first round of shop drawing and schedule the second coordination meeting/ conference call before any low voltage systems, devices, equipment, etc have been roughed in.
 - 2. The second meeting /conference call shall be scheduled to allow for enough time for the Design-Build Low Voltage Contractor to issue a second set of shop drawings for Owner and Engineer review and comment before rough-in for these systems needs to begin.
 - 3. Any equipment, devices, etc for any low voltage systems roughed-in before the second meeting/ conference call shall be relocated as needed at the Contractor's expense.

1.4 SYSTEMS REQUIREMENTS

- A. The Fire Alarm and Low Voltage Contractors shall provide all racks, parts, pieces, cabling, equipment, devices, supports, etc required for complete and fully operational low voltage and fire alarm systems per Code, AHJ, and Owner requirements.
- B. FIRE ALARM SYSTEM
 - 1. See Specification Section 28 46 00.
- C. TELECOM AND CATV SERVICES:
 - 1. The Contractor shall coordinate with the Owner to confirm the desired telecom utilities for the project. For bidding purposes, assume three providers for the building (CenturyLink, and Xfinity/Comcast).
 - 2. The Electrical Contractor shall coordinate with the Owner's desired telecom providers to bring service to the building.
 - 3. The Electrical Contractor shall also coordinate with any existing providers at the site to relocate and/ or remove all existing conduit and cabling in conflict with the scope of the project.
 - 4. See Site Plan for preliminary conduit requirements and service points. Contractor to confirm final requirements and service points with utility service providers.
 - a. For CenturyLink service conduits, maximum allowed is two 90-degree bends before a CenturyLink approved pull box must be installed.
 - b. For Comcast service conduits, maximum allowed is 270 degrees of bends. Provide 36-inch radius sweeps.
- D. TELECOM AND CATV SYSTEMS:
 - 1. See the Bid Set Electrical drawings for additional information and requirements including preliminary device quantities and locations for bidding purposes.

2. The Contractor shall design, provide and install complete and fully operational Telecom and CATV systems for the project. Coordinate exact requirements, locations and device types with the Owner.
3. Telecom equipment and cabling shall meet TIA performance criteria for Category 6. All cabling is to be terminated with Category 6 jacks.
4. The Design-Build Contractor shall coordinate with the Owner to confirm telecom system requirements prior to the start of design.
5. The CATV system shall consist of cable television service and a coaxial cable distribution system.
 - a. Headend equipment shall consist of receiving equipment and associated signal distribution amplification and equalization.
 - b. Distribution of cable television service signals, which includes coordinating with Owner's selected service provider for installation of cable to the service point ready for connection into the distribution system. Obtain signal levels and noise and distortion characteristics from service provider as the point of departure for system layout and final equipment selection.
 - c. Cable distribution system consisting of coaxial cables, user interfaces, signal taps and splitters, RF amplifiers, signal equalizers, power supplies, and required hardware, complying with CEA-310-E and CEA-2032 and resulting in performance parameters specified in this Section. System shall be capable of distributing television channels according to CEA-542-B.
6. In addition to devices noted on the Bid Set drawings, the Design-Build Contractor shall also provide:
 - a. Dedicated phone lines for the access control, fire alarm and two-way communication systems and for the elevator as required by Code, local AHJ and the Fire Marshal.
 - b. Any other devices required by Code, AHJ or Fire Marshal.

E. WIRELESS NETWORKS

1. The Contractor shall provide wireless access points and all other equipment required to provide a secured wireless network at all offices and in all amenity rooms.

F. ACCESS CONTROL SYSTEM

1. The Contractor shall design, provide and install a complete and fully operational key fob reader-based access control system for the project.
2. The Access Control System basis of design shall be Kantech with HID Standard 26-bit Wiegand Format card readers and HID 1346 keyfobs (HID ProxPro, not ProxPlus).
3. Contractor to coordinate with owner to determine any compatibility requirements with any existing system.
4. The system shall interconnect with the Front Entry to allow the Front Desk to remotely unlock the front doors.
5. The system shall include a USPS lock core for USPS access into building. USPS to provide and install core in prepped access control panel.
6. The system shall be designed to support all locations indicated in the Low Voltage preliminary plans plus an additional 25% future capacity.

G. CCTV SYSTEM

1. The CCTV system requirements are being determined by a third party. The contractor is to coordinate exact requirements, locations and device types with the third party.
2. See the third party basis of design drawing set for additional information and requirements.

H. SECURITY SYSTEM

1. The security system requirements are being determined by a third party. The contractor is to coordinate exact requirements, locations and device types with the third party.
2. See the third party basis of design drawing set for additional information and requirements.

I. AUDIO/ VISUAL SYSTEM

1. The audio/ visual system is being designed by the Greenbusch Group. Refer to their design drawings and specifications for the full system requirements.
 - a. The electrical contractors and design-build low voltage subcontractor are responsible for coordinating directly with the AV designer to confirm scope and material responsibility.
2. All devices shown on the Electrical Bid Set are based on preliminary design information received in May 5th, 2023. This scope is meant to be a placeholder for scope coordination.

1.5 CODES AND STANDARDS:

- A. All work shall meet or exceed the requirements of the current versions of all applicable Federal, State, and Local Codes and Standards including but not limited to:
1. National Electrical Code (NEC) with Local Amendments.
 2. Washington State Energy Code with Local Amendments.
 3. ESDS Requirements.
 4. International Fire Code (IFC) with Local Amendments.
 5. International Building Code (IBC) with Local Amendments.
 6. International Mechanical Code (IMC) with Local Amendments.
 7. Uniform Plumbing Code (UPC) with Local Amendments.
 8. The Americans with Disabilities Act (ADA).
 9. Illuminating Engineering Society of North America (IESNA) Standards and Recommended Practices.
 10. National Fire Protection Association (NFPA) Standards and Recommended Practices.
 11. Applicable Standards of the following organizations (see subsequent Division 26, 27 and 28 sections for additional information):
 - a. American National Standards Institute (ANSI).
 - b. American Society for Testing Materials (ASTM).
 - c. Building Industry Consulting Services International (BICSI)
 - d. Institute of Electrical and Electronics Engineers (IEEE)
 - e. National Electrical Manufacturer's Association (NEMA)
 - f. U.S. Department of Housing and Urban Development (HUD)
 - g. Underwriter's Laboratories (UL) standards.

12. Utility Service Provider Requirements.

1.6 SUSTAINABLE DESIGN REQUIREMENTS:

- A. Comply with Construction Management Plan. Refer to Division 01.
- B. ESDS-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC per referenced standards in Rating System Requirements and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and SG-40, or the California Code of Regulations, Title 17 Section 94509, VOC standards for cleaning products.
- C. Refer to Division 01 for a complete list of ESDS Prerequisites and Credits anticipated for the project.

1.7 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to International Building Code with local amendments, Fire Marshal, and UL for fire resistance ratings and surface burning characteristics.

1.8 PRODUCT SUBSTITUTIONS

- A. Manufacturers and models of equipment and material indicated in Divisions 27 and 28 Specifications and on drawings are those upon which the fire alarm and low voltage systems designs are to be based; other manufacturers with products considered equal in general quality may also be listed without specific model designation. Manufacturers not listed shall be submitted for approval prior to submission of Bid by the Contractor, see Division 01.
- B. Any equipment other than the basis of design is considered a substitution; this includes equipment from any alternate manufacturers listed without specific model designation in the Contract Specifications and / or Drawings.
- C. Pre-Bid Substitutions will be evaluated based on product manufacturer only. Specific product model, specifications, options and accessories will be evaluated during submittals. Approval of a manufacturer substitution does not constitute approval of the submitted product.
- D. In selecting substitute equipment, the Contractor is responsible for and shall guarantee equal performance and fit. Cost of redesign and all additional costs incurred to accommodate the substituted equipment shall be borne by the Contractor.
- E. Approval of proposed substitution does not grant the Contractor approval for deviation from the contract requirements.
- F. Unless indicated otherwise, "or approved equal" may be assumed for all products in Divisions 26, 27 and 28.

1.9 DESIGN DRAWINGS

- A. All drawings, specifications and calculations prepared by the Fire Alarm Design-Build Contractor shall be stamped by an Engineer currently registered in the State of Washington.
- B. The Design-Build Contractor shall submit drawings and diagrams for review and for job coordination :
 - 1. Permit / Construction Drawings for review. These drawings shall be submitted at two milestones as selected by the Architect in electronic PDF format.
 - a. The Contractors' drawings shall match the layout of the Architectural drawings.
 - b. Fire Alarm systems shall be provided in a separate set of drawings by the Fire Alarm Contractor.
 - c. The Drawing Sets shall include at a minimum:
 - 1) Symbols, Legend and drawing list sheets.
 - 2) Low Voltage Systems (Telecom, CATV, access control, etc) floor plan drawings.
 - 3) Low Voltage Systems riser diagrams.
 - 4) Fire Alarm System sheets and calculations approved by the local Fire Marshal/ AHJ.

1.10 SUBMITTALS

- A. Provide one electronic copy of product data submittals for all products listed under "Part 2 Products" of Divisions 27 and 28 Specification Sections and all additional products noted on drawings or required for completion of sequence of operations.
- B. Provide the Submittals so as not to delay the construction schedule; allow at least two weeks for review of each submittal and re-submittal.
- C. Electronic: Submittals shall be complete in one PDF file for each Division with bookmarks for each Specification Section and Principal Category. Multi-file submittals will be returned without review.
 - 1. First Page: Name of Project, Owner, Location & Contracting Company.
 - 2. Index Page: List of specification sections and principal categories with contents by Tag or item.
 - 3. Bookmarks: Electronic bookmark of each specification section and principal category corresponding to listing in index.
- D. Clearly indicate on each page the equipment schedule designation (Tag) and/or specification section, as applicable. Indicate selected model and all accessories intended for use.
- E. Equipment vendor cover page with contact information shall precede submittal by that vendor.
- F. Submitted product information shall include (as applicable) but not be limited to the following information:
 - 1. Product description.

2. Manufacturer and model.
 3. Dimensions.
 4. Performance Ratings.
 5. Construction Materials.
 6. Ratings (i.e. UL, ASTM, NEMA, etc).
 7. Electrical characteristics (Voltage, Phase, Wattage, Breakers, etc).
 8. Engineering technical data.
 9. Sound level data.
 10. Vibration Isolation.
 11. Controls and wiring diagrams.
 12. Accessories.
- G. If requested in subsequent Specification Sections or by Architect or Engineer, submit Manufacturer's Installation Instructions on any equipment, procedures, or certifications so requested.
- H. Do no ordering, fabrication or manufacturing of products until return of approved submittals.
- I. The Contractor agrees to pay for the Engineer's review cost of the Division 27 and 28 Submittals beyond one resubmittal where resubmittals are required due to deficiencies in the Contractor's Submitted material.

1.11 SHOP DRAWINGS

- A. The Contractor shall submit drawings and/or diagrams for review and for job coordination:
1. Slab plans marked up with all penetrations required for electrical, fire alarm and low voltage systems. Sizes of penetrations shall be indicated on the plans and penetration locations shall be dimensioned from major building lines. The Contractor shall submit these slab plans to the Architect for review.
 2. For all special or custom-built items or equipment.
 3. In all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by the Engineer for purposes of clarification of the Contractor's intent.
 - a. By submission of revised design shop drawings, the Contractor acknowledges that coordination has been done with all other trades to ensure that all equipment fits and remains accessible with all Code required clearances and that no conflicts exist.
- B. The Architect's review of shop drawings shall not relieve the Contractor of the responsibility for deviations from the Contract drawings or specifications, unless he has, in writing, called the attention of the Architect to such deviations at the time of the submission, nor shall it relieve him from responsibility for errors or omission in such shop drawings.

1.12 ESDS RELATED DOCUMENTATION AND ACTIVITIES

- A. Provide commissioning documentation per EA Prerequisite 1 and as the Commissioning Authority (CxA) requests.

- B. Comply with IAQ Management Plan by the general contractor.
- C. Submit the ESDS VOC Form, for any VOC-containing material to be used inside the building envelope, including materials for patching, touch-up and cleaning
- D. Construction Waste Management: Retain and submit all trip and tip tickets for all construction debris and waste removed from site, indicating material content, tonnage, date hauled and facility to where materials were hauled. This submittal is to the general contractor only.

1.13 PLAN REVIEW AND PERMITS

- A. In addition to the distribution requirements specified in other Specification Sections, the Design-Build Contractors shall make all required submissions to the Authorities Having Jurisdiction (AHJ) for Plan Review, Permits and approval for applicable low voltage systems (Fire Alarm, Two-Way Communication, etc). The Contractors shall pay all fees related to said submissions. The Contractors shall revise their design and resubmit as needed to obtain AHJ approval. All additional and / or revisions to the Contractor's designs required to obtain AHJ approval shall be carried out by the Contractor at no additional cost to the Owner – this includes the fees associated with any resubmissions. The Contractors shall submit all comments received from the AHJ to the Architect and Engineer.
- B. The Contractor shall not commence work until a permit (or "get started" permit where allowed by the AHJ) is obtained. Contractor is solely responsible for ensuring that the permit application and any revisions are submitted in a timely manner so as not to impact project schedule.

1.14 QUALITY ASSURANCE

- A. The Contractors shall perform all work per current versions of all applicable Codes and Standards with state and local amendments – see "Codes and Standards" paragraph above.
- B. All equipment and devices shall be UL-Listed and Labeled and shall be acceptable to the Authority Having Jurisdiction as suitable for the use and location for which they are intended.
- C. Provide all like items (telecom outlets, patch panels, faceplates, etc) from one manufacturer.

1.15 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in Divisions 27 and 28 Specification Sections with a minimum of three years' experience.
- B. Installer: Company specializing in performing Work included in Divisions 27 and 28 on projects of similar type and scale with a minimum of three years' experience.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. The Contractor shall keep all equipment, devices, conduit, etc in a dry, secured, protected area. The location shall be coordinated with the Architect and General Contractor prior to the start of Construction. See Division 01 for additional delivery, storage and handling requirements.
- C. Where original packaging is insufficient, provide additional protection. Maintain protection in place until installation.
- D. Inspect all products and materials for damage prior to installation.
- E. Protect conduit from all entry of foreign materials by providing temporary end caps or closures on conduit and fittings.
- F. Protect materials and finishes during handling and installation to prevent damage.
- G. Comply with manufacturer's installation instruction for rigging, unloading and transporting equipment.

1.17 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.
- B. Coordinate with General Contractor to have ventilation provided in areas to receive solvent cured materials.
- C. Do not install underground conduit when bedding is wet or frozen.

1.18 FIELD MEASUREMENTS

- A. Verify field measurements prior to ordering racks and other equipment.
- B. Verify by field measurements that equipment and rack sizes and configurations are compatible with wall construction and layout.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining and documenting exact locations of existing systems.

1.19 COORDINATION

- A. The Contractor shall visit the site and become familiar with existing conditions affecting work. The Contractor shall include in their Bid the costs for all work and / or materials required to comply with the requirements of the Contract Documents based on the actual existing conditions. Failure to visit the Site and

verify actual existing conditions does not relieve the Contractor of these requirements; no change orders will be paid due to lack of verification of existing conditions whether they are specifically noted in the Contract Documents or not.

- B. The Contractor shall verify the locations of any overhead or buried utilities on or near the Project site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.
- D. Where the word 'verify' is used on the documents, the contractor shall field verify the existing conditions and modify the scope of the installation as required to meet the verified conditions without additional cost to the Owner.
- E. Where the drawings or specifications call out for the contractor to field verify and / or coordinate locations and requirements this verification / coordination is to be completed prior to any equipment, devices, supports, conduits, etc are installed / roughed-in. Any equipment, devices, supports, conduits, etc installed at locations unacceptable to the design team (either for aesthetics or functionality) due to the contractor failing to field verify / coordinate shall be relocated at the contractor's expense.
- F. Electrical and Low Voltage Systems drawings are diagrammatic and do not indicate all possible site conditions. The contractor shall verify all measurements, dimensions and connections on site and coordinate between trades to preclude interferences. The contractor shall provide adjustments as necessary to fit actual conditions.
- G. The scale of each drawing is relatively accurate, but the Contractor is warned to obtain the necessary dimensions for any exact takeoffs from the Architect. No additional cost to the Owner will be considered for failure to obtain exact dimensions where not clear or in error on the drawings. Any device or equipment roughed in improperly and not positioned on implied centerlines or as required by good practice shall be repositioned at no cost to the Owner.
- H. In the event of a conflict with other trades of work, the following priority from highest to lowest shall be followed: Structural, lighting, HVAC, plumbing/piping and sprinklers. Starting with the lowest priority, the Electrical, HVAC, plumbing, and sprinkler contractors shall provide whatever materials, offsets, labor etc. is required to resolve the conflict.
- I. Advise the Architect of any modifications required to suit the equipment furnished. Costs for modifications due to equipment substitution will be borne by the contractor.
- J. When discrepancies occur between plans and specifications, the Architect will determine which takes precedence and the Contractor shall perform the selected requirement at no additional cost.

- K. Wherever conflicts occur between different parts of the Contract Documents the greater quantity, the better quality, or larger size shall prevail unless the Architect informs the Contractor otherwise in writing.
- L. Coordinate trenching, excavating, bedding, backfilling of buried systems with requirements of this specification.
- M. Coordinate wall openings, rough-in locations, concrete housekeeping pads, and conduit rough-in locations to accommodate Work of Divisions 26, 27 and 28.
- N. The Contractor shall coordinate with the Architectural plans and Project structure when locating equipment and devices and routing conduit and cabling.
- O. The Contractor shall coordinate with the General Contractor and provide slab plans marked up with all penetrations required for electrical, fire alarm and low voltage systems. Sizes of penetrations shall be indicated on the plans and penetration locations shall be dimensioned from major building lines. The Contractor shall submit these slab plans to the Architect for review.
- P. The Contractor shall coordinate conduit and cabling routing and equipment and device locations with all other trades to ensure all Code required clearances are maintained and equipment and devices remain accessible after the work of all trades is complete.
- Q. The Contractor shall consult the approved shop drawings of all other trades and crafts to ensure coordination with final locations of cabinetry, counters, appliances, equipment, structural members, etc. Conflicts are to be resolved with the Architect and General Contractor prior to rough-in. The Contractor shall not be paid for relocation work (including cutting, patching, and finishing) required due to a lack of coordination prior to installation.
- R. See the Architectural drawings for the exact locations of low voltage devices. The Contractor shall make minor changes (less than 6-feet in any direction) in the location of conduit, boxes, devices, etc from the locations shown in the drawings without extra charge to the Owner where required by coordination or if directed by the Architect or Owner.
- S. Prior to the start of Construction, coordinate locations and connection requirements for all line voltage power connections with the Electrical Contractor and Engineer.

1.20 PROJECT CLOSEOUT

- A. Completion, submission and approval of the following is required for final project closeout:
 - 1. Walk through the Project with the Owner and Architect to make note of deficiencies.
 - 2. Execution of Owner's, Architect's and Engineer's final observation reports (punchlist).
 - 3. Operating and Maintenance Instructions.
 - 4. Operating and Maintenance Manual.
 - 5. Equipment Cleaning.

6. Record Drawings.
7. Testing.
8. Commissioning and Commissioning Report.
9. Warranty.

- B. See other Divisions 01, 27 and 28 Specification Sections for additional requirements.

1.21 OPERATING AND MAINTENANCE INSTRUCTIONAL TRAINING

- A. General: In addition to requirements of Division 01, following initial operation of Electrical systems and prior to acceptance by the Architect, perform the following services:
1. At least two weeks prior to each instruction period, give written notification of readiness to proceed to the Architect and Owner, and obtain mutually acceptable dates.
 2. Conduct demonstrations and instructions for the Owner's representatives, pointing out requirements for operating, servicing and maintaining equipment and systems. Describe general system operation and specific equipment functions. Cover all equipment and device calibration; systems set up, adjustments and programming; and safeties and alarms.
 3. Furnish qualifications of Contractor's personnel in charge of the instruction; foreman position is minimum acceptable. Where equipment startup is performed by supplier's or manufacturer's personnel, those personnel should also provide training on that equipment.
 4. During demonstrations and instructions include and reference information from maintenance manuals and contract drawings.
 - a. Provide documentation of all instruction which includes:
 - 1) Date and time of instruction.
 - 2) Name, affiliation and qualifications of the instructor.
 - 3) Name and affiliation of the attendees.
 - 4) Topics, systems, and equipment covered.
 - 5) Length of instruction.
 5. Minimum duration of instruction periods:

a. Telecom and CATV Systems	1 hour
b. CCTV System	2 hours
c. Access Control System	3 hours
d. Fire Alarm Systems	See Section 28 46 00

1.22 OPERATING AND MAINTENANCE MANUALS

- A. Contents: Furnish, in accord with Division 01, one PDF and one bound copy of operating and maintenance manuals to include the following:
1. The Job name and address.
 2. Names, addresses and telephone numbers of the Contractor, sub-contractors and local companies responsible for maintenance of each system or piece of equipment.
 3. Manufacturers, suppliers, contractor names, addresses and phone numbers.
 4. Written guarantees.

5. Warranty service contractors' names, address and phone numbers (if different from above).
 6. Copies of approved brochures and Shop Drawings as applicable for all submittal items.
 7. Manufacturer's printed operating procedures to include start-up and routine and normal operating instructions; and control, shutdown, and emergency instructions.
 8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; and adjusting instructions.
 9. Part numbers of all replaceable items.
 10. Operation sequences.
 11. Record drawings corrected and completed.
 12. Completed equipment start-up forms and checklists.
 13. Final copy of testing reports.
- B. Operation and Maintenance Data:
1. Include spare parts lists for all equipment as applicable.
 2. Submit installation instructions, adjustment instructions, and spare parts lists for all equipment.
 3. Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 4. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.
- C. Binders:
1. Furnish typewritten or printed index and tabbed dividers between principal categories.
 2. Bind each manual in a hard-backed loose-leaf binder.
 3. Imprint on Cover:
 - a. Name of Project.
 - b. Owner.
 - c. Location of project.
 - d. Architect.
 - e. Contractor.
 - f. Year of Completion.
 4. Imprint on backing:
 - a. Name of Project.
 - b. Year of completion.
- D. PDFs:
1. Provide PDF with bookmarks for each Specification Section and / or Principal Category.
 - a. First Page: Name of Project, Owner, Location & Contracting Company.
 - b. Index Page: List of specification sections with contents by Tag or item.
 - c. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- E. Submittal:

1. Preliminary Copies: Prior to scheduled completion of the project, submit one PDF copy for review by the Architect.
2. Final Copies: After approval of the preliminary copy, submit one PDF and one bound copy to the Owner.

1.23 RECORD DRAWINGS

- A. Prepare record documents in accordance with the requirements of Division 01 Specification Section "Contract Closeout."
- B. Label each drawing as "Record Drawing" with Low Voltage Contractors' name and date.
- C. During construction, maintain an accurate record set of the drawings of the installation on project site at all times; keep this set in a safe location, protected from the environment.
- D. Submit one digital file with all drawings in PDF format.
- E. Make all notes and revisions on PDF set in red.
- F. In addition to the requirements specified in Division 01 and in other Division 26, 27 and 28 Specification Sections, indicate installed conditions (locations, sizes, burial depths, arrangements, etc) for:
 1. Major raceway systems – Interior and Exterior – dimensions from prominent building lines.
 2. Utility service conduit (power and telecom) and connections, dimensions from prominent building lines.
 3. Locations of all conduits provided for future use with intended future use identified.
 4. Equipment locations (exposed and concealed) shown to scale and dimensioned from prominent building lines.
 5. Final numbering for all low voltage terminations.
 6. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.24 TESTING

- A. All cabling shall be tested by a certified installer.
- B. Provide completed start-up forms and checklists.
 1. Contractor to test all horizontal UTP cables per TIA 568.B.2 for CAT6 performance requirements.
- C. Perform testing of fire alarm, two-way communications, and DAS systems as described in Division 26, 27 and 28 Specification Sections and as required by applicable codes and ordinances.
- D. Written verification of testing to be signed by Owner's Representative.

1.25 WARRANTY AND CONTRACTOR'S GUARANTEE

- A. All work, material and equipment shall be free of defect, complete and in perfect operating order at time of delivery to Owner.
- B. The Contractor shall, without cost to the Owner, correct all defects and failures discovered within one year from date of final acceptance for all electrical, fire alarm, two-way communications, and DAS systems, except when in the opinion of the Architect a failure is due to neglect or carelessness of the Owner.
 - 1. See individual Specification Sections for additional requirements.
 - 2. Telecom terminations and cabling shall be provided with a 15 year warranty.
- C. The guarantee of the Contractor is independent of shorter time limits by any manufacturer of equipment furnished. Submit with Operation and Maintenance Manual all guarantees which exceed one year.
- D. The Contractor shall make all necessary control adjustments during first year of operation.
- E. The presence of any inspector or observer at any point during construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.
- F. Refer to Division 01, 26, 27 and 28 Specification Sections for additional Warranty requirements.

PART 2 PRODUCTS

2.1 CABLE TRAYS

- A. Subject to compliance with requirements, provide equipment, devices and cabling by one of the following manufacturers or a pre-approved equal:
 - 1. Cable Management Solutions, Inc.
 - 2. Cablofil Inc.
 - 3. Cooper B-Line, Inc.
 - 4. Cope; Atkore International.
 - 5. GS Metals Corp.
 - 6. Monosystems, Inc.
 - 7. MP Husky Cable Tray and Cable Bus.
 - 8. Wiring Device-Kellens; Hubbell Incorporated
- B. Comply with TIA/EIA-569-A.
- C. Sizes and Configurations: See the Drawings for preliminary requirements for types, materials, sizes, and configurations. Confirm final sizes and configurations with the Low Voltage Design-Build Contractor.
- D. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.
- E. Description:
1. Width: as indicated on Drawings.
 2. Minimum Usable Load Depth: 6 inches (150 mm).
 3. Straight Section Lengths: 10 feet (3.0 m) or 12 feet (3.7 m), except where shorter lengths are required to facilitate tray assembly.
 4. Rung Spacing: 6 inches (150 mm) o.c.
 5. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
 6. Support Point: Splice fittings shall be hanger support point.
 7. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
 8. Unbalanced Loads: Maintain cable tray rungs within six degrees of horizontal under all loading conditions.
 9. Splicing Assemblies: Bolted type using serrated flange locknuts.
 10. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 11. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.
 12. Materials: Aluminum alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 13. Hardware: Chromium-zinc-plated steel, ASTM F1136.
- F. CABLE TRAY GROUNDING
1. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" and the design drawings.
 2. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
 3. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
 4. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

2.2 UTP CABLE

- A. Subject to compliance with requirements, provide equipment, devices and cabling by one of the following manufacturers or a pre-approved equal:
1. Belden CDT, Inc, Electronics Division.
 2. Berk-Tek.
 3. CommScope, Inc.
 4. KRONE, Inc.
 5. Superior Essec, Inc.

- B. Description: 100-ohm, 100 pair UTP formed into 25-pair binder groups covered with thermoplastic jacket.
 - 1. Comply with TIA/ EIA-568-B.2, Category 6.

2.3 TELECOM/ CATV EQUIPMENT:

- A. Subject to compliance with requirements, provide equipment, devices and cabling by one of the following manufacturers:
 - 1. Belden, Inc.
 - 2. Cooper B-Line.
 - 3. Hubbell Premise Wiring.
 - 4. Legrand.
 - 5. Leviton Commercial Networks Division.
 - 6. Motorola, Inc.; Connected Home Solutions.
 - 7. Ortronics, Inc.
 - 8. Tyco Electronic Corporation.
- B. The telecom equipment, devices and cabling shall meet TIA performance criteria for Category 6. All cabling shall be terminated with Category 6 RJ45 jacks.

2.4 ACCESS CONTROL SYSTEM

- A. See Paragraph 1.4-F above.

2.5 CCTV SYSTEMS

- A. See Paragraph 1.4-G above

2.6 HANGERS AND SUPPORTS

- A. See Specification Section 26 00 01.

2.7 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- A. See Specification Section 26 05 19.

2.8 GROUNDING AND BONDING

- A. See Specification Section 26 05 26.

2.9 RACEWAY AND BOXES

- A. See Specification Section 26 05 33.

2.10 IDENTIFICATION FOR LOW VOLTAGE SYSTEMS

- A. See Specification Section 26 05 53.

PART 3 EXECUTION

3.1 DOCUMENTATION

- A. Additional plan submittals to reviewing authority: If additional drawing submittals are required at any time during construction the Contractor shall submit drawings, review with authority, and pick up subsequent approved drawings. The Contractor will revise and/or prepare drawings for submittal.

3.2 MOCK-UPS

- A. The Contractor shall completely mock-up the common areas (areas to be chosen by the Architect and Owner) by marking the intended locations of all equipment and devices.
- B. Before starting installation of equipment and devices, the Electrical Contractor shall walk through all mocked-up areas with the Owner, Architect, and General Contractor to receive approval for all locations.
- C. The Electrical Contractor shall relocate equipment and devices in the mock-ups per the Owner and Architect's instructions.
- D. The Electrical Contractor shall relocate any equipment and devices installed prior to the approval of the mocked-up areas by the Architect and Owner at the Electrical Contractor's expense.

3.3 INSTALLATION

- A. The Contractor shall conceal all conduit, cabling and boxes in finished areas unless indicated otherwise or granted specific permission by the Architect. Install all conduit and cabling perpendicular or parallel with building lines wherever possible.
- B. In open ceiling areas, all cabling shall be installed in conduit. Conduit shall be painted; color as selected by the Architect.
- C. Coordinate the locations of equipment and outlets with all other trades.

3.4 INSPECTION

- A. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work (including the electric and telecom utility providers for utility service infrastructure work).
- B. Should any work be enclosed or covered up before such inspection and testing, the Contractor shall at his own expense uncover said work, and after it has been inspected, tested and approved, make all repairs as necessary to restore all work disturbed by him to its original condition including paying other trades to repair work under their scope that was disturbed.

3.5 FIELD QUALITY CONTROL

- A. Conducts tests of equipment, devices, and systems as required by NFPA, BICSI, local Codes and the local AHJ.
 - 1. Provide a Service Technician with all tools, instruments, etc required to complete required tests.
 - 2. Coordinate with the Owner, Architect and General Contractor; tests should be performed in the presence of the Owner and Architect unless given specific permission otherwise.
- B. Refer to individual Division 26, 27 and 28 Specification Sections for additional requirements.

3.6 CLEANING

- A. Clean adjacent surfaces of fire stopping materials.
- B. Clean interior and exterior of all equipment. Equipment shall be free of dirt, construction debris, corrosion, etc.
- C. Adequate provisions shall be made during construction to eliminate dirt, debris or other material from entering and collecting inside of conduit and equipment. Any collection of material shall be thoroughly cleaned before owner occupancy.
- D. Clean exterior of all exposed conduit.
- E. Use ESDS Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

3.7 CUTTING, FITTING, REPAIRING AND PATCHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where necessary for installation of low voltage systems work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting where possible by setting sleeves, frames, etc., and by coordinating for openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for low voltage systems installations.
- C. Cut all holes neatly and as small as possible to admit work. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.8 SALVAGE

- A. Remove excess conduit and conductors. Remove scrap and all other excess materials from the site.
- B. Comply with contractor's Construction Waste Management Plan. Retain and submit all trip and tip tickets for all construction debris and waste hauling,

indicating material content, tonnage, date hauled and facility to where materials were hauled.

3.9 MANUFACTURERS' FIELD SERVICES

- A. Refer to individual Division 26, 27 and 28 Specification Sections for requirements.

3.10 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 28 46 00

FIRE ALARM GENERAL CONDITIONS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 01 - General Requirements for all work in Divisions 26, 27 and 28.

1.2 SUMMARY

- A. **This is a design/build specification.** Contract Documents are meant to provide information (scope, performance requirements, preliminary quantities and locations, etc) for Bidding by Design-Build Contractors only. All final quantities and locations of equipment and devices shall be coordinated with the Fire Marshal/ Local AHJ (as applicable), Architect and Owner prior to the start of construction.
- B. Design Intent: The project includes Electrical, Fire Alarm and Low Voltage systems for the commercial scope of a campus wide substantial renovation to an existing low-income apartment complex consisting of 24 existing apartment buildings owned by King County Housing Authority, located in Kirkland WA. The Commercial scope includes a new 4,000 square foot Community Building.
- C. All Fire Alarm and Low Voltage Systems are Design-Build; Contract Documents (drawings and specifications) are meant to provide information (scope, performance requirements, preliminary quantities and locations, etc) for Bidding by Design-Build Contractors only.
- D. The Fire Alarm and Low Voltage Design-Build Contractor(s) shall be subcontractor(s) to the Electrical Contractor. The Design-Build Contractors shall design, provide and install complete and fully operational and coordinated systems that meet all requirements of the Owner, local AHJ and as per the Project Contract Documents.
 - 1. All voice and data cabling design shall be performed by an RCDD or by a designer with five or more years of experience with telecommunications cabling design. Contractor to provide proof of designer qualifications.
- E. Low Voltage Systems to be provided for the Project include:
 - 1. Fire Alarm System.
 - 2. Telecom Systems.
 - 3. Wireless Network at Community Building.
 - 4. CATV System.
 - 5. CCTV System..
 - 6. Access Control System.

7. Security System (equipment and devices by Others, Low Voltage and Electrical Contractors to pre-wire and provide conduit, boxes, and line voltage power).
 8. Audio/ Visual System.
- F. The Contractor shall provide all labor, materials, equipment and devices, supports, etc necessary for satisfactory installation of fire alarm and low voltage work ready to operate in strict accordance with Code requirements and these specifications and drawings including but not limited to all switches, routers, CCTV cameras and NVR server, racks, patch panels, patch cables, 110 blocks, terminations, etc. The Contractor shall also provide permanent labeling at both ends of all low voltage cabling, color coded for each system, which shall match the numbering scheme of the Low Voltage system As-Built drawings for all terminations.
1. The Contractor shall test all terminations to ensure they are in good working order. Any and all faulty cables and/ or terminations shall be replaced at no cost to the Owner.
- G. All final quantities and locations of equipment and devices shall be coordinated with the Fire Marshal/ Local AHJ (as applicable), Architect and Owner prior to the start of construction.
- H. Sustainability Goals: The Project is pursuing Evergreen Sustainable Development Standards (ESDS) Certification. The Contractor shall coordinate with the Architect and General Contractor to ensure compliance with the Prerequisites and intended Credits for the project. See Division 01 Specification and subsequent Division 26, 27 and 28 Specifications for additional information and requirements.
- I. Related Sections: All Division 01, 26, 27 and 28 Specification Sections included in the Contract Documents.
- J. Commissioning Activities and Submittals: The Project shall be commissioned per Energy Code and ESDS requirements. The Contractor shall coordinate with the General Contractor, Architect and Commissioning Agent and provide support for the complete commissioning process as required. See Divisions 01, 26, 27 and 28 for additional information.

1.3 SYSTEMS REQUIREMENTS

A. FIRE ALARM SYSTEM

1. A complete and fully operational Addressable Fire Alarm system meeting all Code and Fire Marshal requirements shall be designed, provided and installed for the project by the Design-Build Contractor.

1.4 CODES AND STANDARDS:

- A. All work shall meet or exceed the requirements of the current versions of all applicable Federal, State, and Local Codes and Standards including but not limited to:
 - 1. National Electrical Code (NEC) with Local Amendments.
 - 2. Washington State Energy Code with Local Amendments.
 - 3. ESDS Requirements.
 - 4. International Fire Code (IFC) with Local Amendments.
 - 5. International Building Code (IBC) with Local Amendments.
 - 6. International Mechanical Code (IMC) with Local Amendments.
 - 7. Uniform Plumbing Code (UPC) with Local Amendments.
 - 8. The Americans with Disabilities Act (ADA).
 - 9. Illuminating Engineering Society of North America (IESNA) Standards and Recommended Practices.
 - 10. National Fire Protection Association (NFPA) Standards and Recommended Practices.
 - 11. Applicable Standards of the following organizations (see subsequent Division 26, 27 and 28 sections for additional information):
 - a. American National Standards Institute (ANSI).
 - b. American Society for Testing Materials (ASTM).
 - c. Building Industry Consulting Services International (BICSI)
 - d. Institute of Electrical and Electronics Engineers (IEEE)
 - e. National Electrical Manufacturer's Association (NEMA)
 - f. U.S. Department of Housing and Urban Development (HUD)
 - g. Underwriter's Laboratories (UL) standards.
 - 12. Utility Service Provider Requirements.

1.5 SUSTAINABLE DESIGN REQUIREMENTS:

- A. Comply with Construction Management Plan. Refer to Division 01.
- B. ESDS-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC per referenced standards in Rating System Requirements and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards

GS-34, GS-37, and SG-40, or the California Code of Regulations, Title 17 Section 94509, VOC standards for cleaning products.

- C. Refer to Division 01 for a complete list of ESDS Prerequisites and Credits anticipated for the project.

1.6 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to International Building Code with local amendments, Fire Marshal, and UL for fire resistance ratings and surface burning characteristics.

1.7 PRODUCT SUBSTITUTIONS

- A. Manufacturers and models of equipment and material indicated in Divisions 27 and 28 Specifications and on drawings are those upon which the fire alarm and low voltage systems designs are to be based; other manufacturers with products considered equal in general quality may also be listed without specific model designation. Manufacturers not listed shall be submitted for approval prior to submission of Bid by the Contractor, see Division 01.
- B. Any equipment other than the basis of design is considered a substitution; this includes equipment from any alternate manufacturers listed without specific model designation in the Contract Specifications and / or Drawings.
- C. Pre-Bid Substitutions will be evaluated based on product manufacturer only. Specific product model, specifications, options and accessories will be evaluated during submittals. Approval of a manufacturer substitution does not constitute approval of the submitted product.
- D. In selecting substitute equipment, the Contractor is responsible for and shall guarantee equal performance and fit. Cost of redesign and all additional costs incurred to accommodate the substituted equipment shall be borne by the Contractor.
- E. Approval of proposed substitution does not grant the Contractor approval for deviation from the contract requirements.
- F. Unless indicated otherwise, "or approved equal" may be assumed for all products in Divisions 26, 27 and 28.

1.8 DESIGN DRAWINGS

- A. All drawings, specifications and calculations prepared by the Fire Alarm Design-Build Contractor shall be stamped by an Engineer currently registered in the State of Washington.
- B. The Design-Build Contractors shall submit drawings and diagrams for review and for job coordination:

1. Permit / Construction Drawings for review. These drawings shall be submitted at two milestones as selected by the Architect in electronic PDF format.
 - a. The Contractors' drawings shall match the layout of the Architectural drawings.
 - b. The Drawing Sets shall include at a minimum:
 - 1) Symbols, Legend and drawing list sheets.
 - 2) Equipment Schedules.
 - 3) Fire Alarm System sheets and calculations approved by the local Fire Marshal/ AHJ.

1.9 SUBMITTALS

- A. Provide one electronic copy of product data submittals for all products listed under "Part 2 Products" this specification and all additional products noted on drawings or required for completion of sequence of operations.
- B. Provide the Submittals so as not to delay the construction schedule; allow at least two weeks for review of each submittal and re-submittal.
- C. Electronic: Submittals shall be complete in one PDF file with bookmarks for each Specification Section. Multi-file submittals will be returned without review.
 1. First Page: Name of Project, Owner, Location & Contracting Company.
 2. Index Page: List of specification sections with contents by Tag or item.
 3. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- D. Clearly indicate on each page the equipment schedule designation (Tag) and/or specification section, as applicable. Indicate selected model and all accessories intended for use.
- E. Equipment vendor cover page with contact information shall precede submittal by that vendor.
- F. Submitted product information shall include (as applicable) but not be limited to the following information:
 1. Product description.
 2. Manufacturer and model.
 3. Dimensions.
 4. Performance Ratings.
 5. Construction Materials.

6. Ratings (i.e. UL, ASTM, NEMA, etc).
 7. Engineering technical data.
 8. Electrical characteristics (Voltage, Phase, Wattage, Breakers, etc).
 9. Controls and wiring diagrams.
 10. Accessories.
- G. If requested in subsequent Specification Sections or by Architect or Engineer, submit Manufacturer's Installation Instructions on any equipment, procedures, or certifications so requested.
- H. Do no ordering, fabrication or manufacturing of products until return of approved submittals.
- I. The Contractor agrees to pay for the Engineer's review cost of the Fire Alarm Systems Submittals beyond one resubmittal where resubmittals are required due to deficiencies in the Contractor's Submitted material.

1.10 SHOP DRAWINGS

- A. The Contractor shall prepare Shop Drawings stamped and signed by a Certified Designer. Drawings shall be developed in accordance with Code and the State and Local Fire Marshals. Submit PDF copies of these drawings for approval prior to beginning work.
- B. Submit shop drawings to Architect, Local Fire Marshal, and all other approving authorities. Drawings shall be approved by all agencies prior to fabrication or installation. Drawings submitted for Architect's approval shall have been stamped approved by the Fire Department.
- C. The Contractor shall draw the design team's attention to any areas in which they contemplate deviations from the conceptual information shown on the contract documents (e.g., due to site conditions).
- D. These drawings and diagrams shall show the manufacturer's name and catalog number of each piece of equipment used. Also included shall be:
1. Symbols and legend sheet.
 2. Schedules sheets.
 3. Floor Plans showing device locations per Code and Fire Marshal requirements.
 4. Wiring diagrams.
 5. All calculations required for approval by the Fire Marshal and local AHJ.
- E. The Contractor shall also coordinate with the General Contractor and provide slab plans marked up with all penetrations required for fire alarm and area of

refuge systems. Sizes of penetrations shall be indicated on the plans and penetration locations shall be dimensioned from major building lines. The Contractor shall submit these slab plans to the Architect for review.

- F. The Architect's and Engineer's review of shop drawings shall not relieve the Contractor of responsibility for deviations from the Contract drawings or specifications, unless he has, in writing, called the attention of the Architect to such deviations at the time of the submission, nor shall it relieve him from responsibility for errors or omission in such shop drawings.

1.11 ESDS RELATED DOCUMENTATION AND ACTIVITIES

- A. Provide commissioning documentation per EA Prerequisite 1 and as the Commissioning Authority (CxA) requests.
- B. Comply with IAQ Management Plan by the general contractor.
- C. Submit the ESDS VOC Form, for any VOC-containing material to be used inside the building envelope, including materials for patching, touch-up and cleaning
- D. Construction Waste Management: Retain and submit all trip and tip tickets for all construction debris and waste removed from site, indicating material content, tonnage, date hauled and facility to where materials were hauled. This submittal is to the general contractor only.

1.12 PLAN REVIEW AND PERMITS

- A. In addition to the distribution requirements specified in other Specification Sections, the Fire Alarm Design-Build Contractor shall make all required submissions to the Authorities Having Jurisdiction (AHJ) for Plan Review, Permits and approval. The Fire Alarm Contractor shall pay all fees related to said submissions. The Fire Alarm Contractor shall revise their design and resubmit as needed to obtain AHJ approval. All additional and / or revisions to the Fire Alarm Contractor's designs required to obtain AHJ approval shall be carried out by the Fire Alarm Contractor at no additional cost to the Owner – this includes the fees associated with any resubmissions. The Fire Alarm contractor shall submit all comments received from the AHJ to the Architect and Engineer.
- B. The Contractor shall not commence work until a permit (or "get started" permit where allowed by the AHJ) is obtained. Contractor is solely responsible for ensuring that the permit application and any revisions are submitted in a timely manner so as not to impact project schedule.

1.13 QUALITY ASSURANCE

- A. Perform all work per current versions of all applicable Code and Standards with state and local amendments – see "Codes and Standards" paragraph above.

- B. All equipment and devices shall be UL-Listed and Labeled and shall be acceptable to the Authority Having Jurisdiction as suitable for the use and location for which they are intended.
- C. Provide all system components from one manufacturer unless Architect provides written permission to do otherwise.

1.14 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in Specification Sections 28 46 00 and 28 46 21 with a minimum of five years' experience.
- B. Installer: Company specializing in performing Work on projects of similar type and scale with a minimum of three years' experience.

1.15 SCHEDULING

- A. Coordinate with and provide assistance in final adjustment and testing of life safety systems with the General Contractor and Fire Authority.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. The Contractor shall keep all equipment, devices, conduit, etc in a dry, protected area. The location shall be coordinated with the Architect and General Contractor prior to the start of Construction. See Division 01 for additional delivery, storage and handling requirements.
- C. Where original packaging is insufficient, provide additional protection. Maintain protection in place until installation.
- D. Inspect all products and materials for damage prior to installation.
- E. Protect conduit from all entry of foreign materials by providing temporary end caps or closures on conduit and fittings.
- F. Protect materials and finishes during handling and installation to prevent damage.
- G. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

1.17 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.

- B. Coordinate with General Contractor to have ventilation provided in areas to receive solvent cured materials.
- C. Do not install underground conduit when bedding is wet or frozen.

1.18 FIELD MEASUREMENTS

- A. Verify field measurements prior to ordering gear.
- B. Verify by field measurements that equipment sizes and configurations are compatible with wall construction and layout.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining and documenting exact locations of existing systems.

1.19 COORDINATION

- A. The Contractor shall visit the site and become familiar with existing conditions affecting work. The Contractor shall include in their Bid the costs for all work and / or materials required to comply with the requirements of the Contract Documents based on the actual existing conditions. Failure to visit the Site and verify actual existing conditions does not relieve the Contractor of these requirements; no change orders will be paid due to lack of verification of existing conditions whether they are specifically noted in the Contract Documents or not.
- B. The Contractor shall verify the locations of any overhead or buried utilities on or near the Project site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.
- D. Where the word 'verify' is used on the documents, the contractor shall field verify the existing conditions and modify the scope of the installation as required to meet the verified conditions without additional cost to the Owner.
- E. Where the drawings or specifications call out for the contractor to field verify and / or coordinate locations and requirements this verification / coordination is to be completed prior to any equipment, devices, supports, conduits, etc are installed / roughed-in. Any equipment, devices, supports, conduits, etc installed at locations unacceptable to the design team (either for aesthetics or functionality) due to the contractor failing to field verify / coordinate shall be relocated at the contractor's expense.

- F. Electrical and Low Voltage Systems drawings are diagrammatic and do not indicate all possible site conditions. The contractor shall verify all measurements, dimensions and connections on site and coordinate between trades to preclude interferences. The contractor shall provide adjustments as necessary to fit actual conditions.
- G. The scale of each drawing is relatively accurate, but the Contractor is warned to obtain the necessary dimensions for any exact takeoffs from the Architect. No additional cost to the Owner will be considered for failure to obtain exact dimensions where not clear or in error on the drawings. Any device or equipment roughed in improperly and not positioned on implied centerlines or as required by good practice shall be repositioned at no cost to the Owner.
- H. In the event of a conflict with other trades of work, the following priority from highest to lowest shall be followed: Structural, lighting, HVAC, plumbing/piping and sprinklers. Starting with the lowest priority, the Electrical, HVAC, plumbing, and sprinkler contractors shall provide whatever materials, offsets, labor etc. is required to resolve the conflict.
- I. Advise the Architect of any modifications required to suit the equipment furnished. Costs for modifications due to equipment substitution will be borne by the contractor.
- J. When discrepancies occur between plans and specifications, the Architect will determine which takes precedence and the Contractor shall perform the selected requirement at no additional cost.
- K. Wherever conflicts occur between different parts of the Contract Documents the greater quantity, the better quality, or larger size shall prevail unless the Architect informs the Contractor otherwise in writing.
- L. Coordinate trenching, excavating, bedding, backfilling of buried systems with requirements of this specification.
- M. Coordinate wall openings, rough-in locations, and conduit rough-in locations to accommodate Work of Specification Sections 28 46 00 and 28 46 21.
- N. Coordinate all equipment with building control work.
- O. The Contractor shall coordinate with the Architectural plans and Project structure when locating equipment and devices and routing conduit and cabling.
- P. The Contractor shall coordinate with the General Contractor and provide slab plans marked up with all penetrations required for electrical, fire alarm and low voltage systems. Sizes of penetrations shall be indicated on the plans and penetration locations shall be dimensioned from major building lines. The Contractor shall submit these slab plans to the Architect for review.

- Q. The Contractor shall coordinate conduit and cabling routing and equipment and device locations with all other trades to ensure all Code required clearances are maintained and equipment and devices remain accessible after the work of all trades is complete.
- R. The Contractor shall consult the approved shop drawings of all other trades and crafts to ensure coordination with final locations of cabinetry, counters, appliances, equipment, structural members, etc. Conflicts are to be resolved with the Architect and General Contractor prior to rough-in. The Contractor shall not be paid for relocation work (including cutting, patching, and finishing) required due to a lack of coordination prior to installation.
- S. Prior to the start of Construction, coordinate locations and connection requirements for all line voltage power connections with the Electrical Contractor and Engineer.

1.20 PROJECT CLOSEOUT

- A. Completion, submission and approval of the following is required for final project closeout:
 - 1. Walk through the Project with the Owner and Architect to make note of deficiencies.
 - 2. Execution of Owner's, Architect's and Engineer's final observation reports (punchlist).
 - 3. Operating and Maintenance Instructions.
 - 4. Operating and Maintenance Manual.
 - 5. Equipment Cleaning.
 - 6. Record Drawings and set of plans stamped approved by Fire Marshal.
 - 7. Testing.
 - 8. Commissioning.
 - 9. Warranty.
- B. See Division 01 for additional requirements for the fire alarm system.
- C. See other Divisions 26, 27 and 28 Specification Sections for complete project requirements.

1.21 OPERATING AND MAINTENANCE INSTRUCTIONAL TRAINING

- A. General: In addition to requirements of Division 01, following initial operation of Electrical systems and prior to acceptance by the Architect, perform the following services:

1. At least two weeks prior to each instruction period, give written notification of readiness to proceed to the Architect and Owner, and obtain mutually acceptable dates.
2. Conduct demonstrations and instructions for the Owner's representatives, pointing out requirements for operating, servicing and maintaining equipment and systems. Describe general system operation and specific equipment functions. Cover all equipment calibration, lighting controls setpoint adjustment, safeties and alarms.
3. Furnish qualifications of Contractor's personnel in charge of the instruction; foreman position is minimum acceptable. Where system startup is performed by supplier's or manufacturer's personnel, those personnel should also provide training on that equipment.
4. During demonstrations and instructions include and reference information from maintenance manuals and contract drawings.
 - a. Provide documentation of all instruction which includes:
 - 1) Date and time of instruction.
 - 2) Name, affiliation and qualifications of the instructor.
 - 3) Name and affiliation of the attendees.
 - 4) Topics, systems, and equipment covered.
 - 5) Length of instruction.
5. Minimum duration of instruction periods:
 - a. Fire Alarm Systems 2 hours

1.22 OPERATING AND MAINTENANCE MANUALS

- A. Contents: Furnish, in accord with Division 1, one PDF and one bound copy of operating and maintenance manuals to include the following:
 1. The Job name and address.
 2. Names, addresses and telephone numbers of the Contractor, sub-contractors and local companies responsible for maintenance of each system or piece of equipment.
 3. Manufacturers, suppliers, contractor names, addresses and phone numbers.
 4. Written guarantees.
 5. Warranty service contractors' names, address and phone numbers (if different from above).

6. Copies of approved brochures and Shop Drawings as applicable for all submittal items.
 7. Manufacturer's printed operating procedures to include start-up and routine and normal operating instructions; and control, shutdown, and emergency instructions.
 8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; and adjusting instructions.
 9. Part numbers of all replaceable items.
 10. Operation sequences.
 11. Record drawings corrected and completed.
 12. Completed equipment start-up forms and checklists.
 13. Final copy of testing reports.
- B. Operation and Maintenance Data:
1. Include spare parts lists for all equipment as applicable.
 2. Submit installation instructions, adjustment instructions, and spare parts lists for all equipment.
 3. Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 4. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.
- C. Binders:
1. Furnish typewritten or printed index and tabbed dividers between Specification Sections and principal categories.
 2. Bind each manual in a hard-backed loose-leaf binder.
 3. Imprint on Cover:
 - a. Name of Project.
 - b. Owner.
 - c. Location of project.
 - d. Architect.
 - e. Contractor.
 - f. Year of Completion.
 4. Imprint on backing:

- a. Name of Project.
 - b. Year of completion.
- D. PDFs:
 - 1. Provide PDF with bookmarks for each Specification Section and Principal Category.
 - a. First Page: Name of Project, Owner, Location & Contracting Company.
 - b. Index Page: List of specification sections with contents by Tag or item.
 - c. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- E. Submittal:
 - 1. Preliminary Copies: Prior to scheduled completion of the project, submit one PDF copy for review by the Architect.
 - 2. Final Copies: After approval of the preliminary copy, submit one PDF and one bound copy to the Owner.

1.23 RECORD DRAWINGS

- A. Prepare record documents in accordance with the requirements of Division 01 Specification Section "Contract Closeout."
- B. Label each drawing as "Record Drawing" with Electrical Contractors' name and date.
- C. During construction, maintain an accurate record set of the drawings of the installation on project site at all times; keep this set in a safe location, protected from the environment.
- D. Submit one digital file with all drawings in PDF format.
- E. Make all notes and revisions on PDF set in red.
- F. In addition to the requirements specified in Division 01 and in other Division 26, 27 and 28 Specification Sections, indicate installed conditions (locations, sizes, burial depths, arrangements, etc) for:
 - 1. Equipment locations (exposed and concealed) shown to scale and dimensioned from prominent building lines.
 - 2. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.24 TESTING

- A. Perform testing of fire alarm systems as described in this Specification and as required by applicable codes and ordinances.
- B. Written verification of testing to be signed by Owner's Representative.
- C. Perform testing of fire alarm and area of refuge / two-way call systems as required by applicable codes and ordinances.

1.25 WARRANTY AND CONTRACTOR'S GUARANTEE

- A. All work, material and equipment shall be free of defect, complete and in perfect operating order at time of delivery to Owner.
- B. The Contractor shall, without cost to the Owner, correct all defects and failures discovered within one year from date of final acceptance for all electrical, fire alarm and low voltage systems, except when in the opinion of the Architect a failure is due to neglect or carelessness of the Owner.
 - 1. See individual Specification Sections for additional requirements.
- C. The guarantee of the Contractor is independent of shorter time limits by any manufacturer of equipment furnished. Submit with Operation and Maintenance Manual all guarantees which exceed one year.
- D. The Contractor shall make all necessary adjustments during first year of operation.
- E. The presence of any inspector or observer at any point during construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.
- F. Refer to Division 01, 26, 27 and 28 Specification Sections for additional Warranty requirements.

PART 2 PRODUCTS

2.1 FIRE ALARM SYSTEM:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. FACP and Equipment:
 - a. Edwards Systems Technology.
 - b. Notifier; a Honeywell Company.
 - c. Silent Knight; a GE-Honeywell Company.

- d. Simplex Grinnell.
 - e. Any Alternate Manufacturers must be submitted during the Bid Process for review and approval by the Owner, Architect and Engineer. No Alternates will be accepted after Bid.
2. Wire and Cable:
- a. Comtran Corporation.
 - b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
 - c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
 - d. West Penn Wire/CDT; a division of Cable Design Technologies.
3. Audible and Visual Signals:
- a. Edwards Systems Technology.
 - b. Gentex Corporation.
 - c. Silent Knight; a GE-Honeywell Company.
 - d. Simplex Grinnell.
 - e. System Sensor; a GE-Honeywell Company.
 - f. Any Alternate Manufacturers must be submitted during the Bid Process for review and approval by the Owner, Architect and Engineer. No Alternates will be accepted after Bid.

2.2 HANGERS AND SUPPORTS

- A. See Specification Section 26 00 01.

2.3 GROUNDING AND BONDING

- A. See Specification Section 26 00 01.

2.4 RACEWAY AND BOXES

- A. See Specification Section 26 00 01.

2.5 IDENTIFICATION FOR ELECTRICAL SYSTEMS

- A. See Specification Section 26 00 01.

PART 3 EXECUTION

3.1 DOCUMENTATION

- A. Additional plan submittals to reviewing authority: If additional drawing submittals are required at any time during construction the Contractor shall submit drawings, review with authority, and pick up subsequent approved drawings. The Fire Alarm Contractor will revise and/or prepare drawings for submittal.

3.2 MOCK-UPS

- A. The Contractor shall completely mock-up the common areas (areas to be chosen by the Architect and Owner) by marking the intended locations of all fire alarm systems equipment and devices.
- B. Before starting installation of equipment and devices, the Contractor shall walk through all mocked-up areas with the Owner, Architect, and General Contractor to receive approval for all locations.
- C. The Contractor shall relocate equipment and devices in the mock-ups per the Owner and Architect's instructions.
- D. The Contractor shall relocate any equipment and devices installed prior to the approval of the mocked-up areas by the Architect and Owner at the Electrical Contractor's expense.

3.3 SURFACE PREPARATION

- A. Examine areas and equipment for conditions that would affect performance of the Work. Proceed with installation only after unsatisfactory conditions have been addressed.
- B. Degrease and clean surfaces of any matter that would affect the bond of paint, adhesives or firestopping material.
- C. Remove incompatible materials affecting bond of paint, adhesives or firestopping.
- D. Degrease and clean surfaces to receive adhesive for identification materials.
- E. Obtain permission from Architect before drilling or cutting structural members.
- F. For adhesive anchors, clean holes and prepare per manufacturer's instructions prior to installation.

3.4 INSTALLATION

- A. The Contractor shall conceal all conduit, cabling and boxes in finished areas unless indicated otherwise or granted specific permission by the Architect. Install all conduit and cabling perpendicular to or parallel with building lines wherever possible.

- B. In open ceiling areas, all cabling shall be installed in conduit. In front of house (public) areas, conduit shall be painted; color as selected by the Architect.
- C. Coordinate the locations of equipment and devices with all other trades.
- D. FIRE ALARM DEVICES:
 - 1. Coordinate all locations with Architect and all other trades.
 - 2. No fire alarm devices are to be located above any cove heaters. Any fire alarm devices so located shall be moved at the Contractor's expense.
 - 3. Smoke or Heat Detector Spacing:
 - a. Smooth ceiling spacing shall not exceed the rating of the device.
 - b. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
 - 4. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
 - 5. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
 - 6. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
 - 7. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
 - 8. Visible Alarm-Indicating Devices (where required): Install adjacent to each alarm horn and at least 6 inches (150 mm) below the ceiling.
 - 9. Device Location-Indicating Lights: Locate in public area near device they monitor.
 - 10. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- E. FIRE ALARM SYSTEM WIRING
 - 1. Install wiring according to the following:
 - a. NECA 1.
 - b. TIA/EIA 568-A.
 - c. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the

enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- d. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- e. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. HANGERS AND SUPPORTS

- 1. See Specification Section 26 00 01.

G. VIBRATION AND SEISMIC CONTROLS

- 1. See Specification Section 26 00 01.

H. GROUNDING AND BONDING SYSTEMS

- 1. See Specification Section 26 00 01.
- 2. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

I. RACEWAY AND BOXES

- 1. See Specification Section 26 00 01.

J. IDENTIFICATION FOR ELECTRICAL SYSTEMS

- 1. See Specification Section 26 00 01.
- 2. Install instructions frame in a location visible from the FACP.

K. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.5 INSPECTION

- A. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work.
- B. Should any work be enclosed or covered up before such inspection and test, the Contractor shall at his own expense uncover work, and after it has been

inspected, tested and approved, make all repairs as necessary to restore all work disturbed by him to its original condition including paying other trades repair work under their scope that was disturbed.

3.6 FIELD QUALITY CONTROL

- A. Initial Inspection: The Contractor shall inspect all equipment, devices, conductors, hangers, supports, cable, etc prior to installation to verify that they are: identified properly on the reel identification label, that it is of the proper gauge, that it contains the proper number of pairs, that there is no damage to the equipment/ devices, etc. Note any buckling of the jacket, which would indicate possible problems. Damaged cable, equipment, devices, etc or any component failing to meet specifications shall not be used in the installation.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
 - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - 3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - 4. Testing: Follow procedure and record results complying with requirements in NFPA 72. Detectors that are outside their marked sensitivity range shall be replaced.
 - 5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.7 CLEANING

- A. Clean adjacent surfaces of fire stopping materials.
- B. Clean interior and exterior of all equipment. Equipment shall be free of dirt, construction debris, corrosion, etc.

- C. Adequate provisions shall be made during construction to eliminate dirt, debris or other material from entering and collecting inside of conduit and equipment. Any collection of material shall be thoroughly cleaned before owner occupancy.
- D. Clean exterior of all exposed conduit.
- E. Use ESDS Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

3.8 CUTTING, FITTING, REPAIRING AND PATCHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where necessary for installation of fire alarm systems work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting where possible by setting sleeves, frames, etc., and by coordinating for openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for fire alarm systems installations.
- C. Cut all holes neatly and as small as possible to admit work. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.9 SALVAGE

- A. Remove excess conduit and conductors. Remove scrap and all other excess materials from the site.
- B. Comply with contractor's Construction Waste Management Plan. Retain and submit all trip and tip tickets for all construction debris and waste hauling, indicating material content, tonnage, date hauled and facility to where materials were hauled.

3.10 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION