STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ADDENDUM NO. 3

for

FORT BARRETTE ROAD OPERATIONAL IMPROVEMENTS,

ROOSEVELT AVENUE TO FARRINGTON HIGHWAY

PROJECT NO. 901A-01-19

DISTRICT OF EWA

ISLAND OF OAHU

The following amendments shall be made to the Bid Documents:

A. NOTICE TO BIDDERS

1. Prospective bidders are hereby notified that receiving of sealed bids, scheduled for April 3, 2020, is HEREBY POSTPONED until 2:00 P.M., **WEDNESDAY, April 29, 2020**. **Sealed bids will be received at the Contracts Office**. The attached NOTICE TO BIDDERS dated r3/24/2020 shall be incorporated and made a part of the NOTICE TO BIDDERS.

B. TABLE OF CONTENTS

1. Delete Table of Contents dated 2/3/2020 and replace it with the attached Table of Contents dated r3/24/2020.

C. SPECIFICATIONS

1. Delete Section 209 dated 10/1/17 and replace it with the attached Section 209 dated r3/24/2020.

2. Delete Section 623 dated 12/31/19 and replace it with the attached Section 623 dated r3/24/2020.

3. Delete Section 627 dated 1/9/2020 and replace it with the attached Special Provision Section 627 dated r3/24/2020.

4. Delete Section 631 dated 1/24/2020 and replace it with the attached Section 631 dated r3/24/2020.

5. Delete Section 632 dated 2/3/2020 and replace it with the attached Section 632 dated r3/24/2020.

6. Delete Section 638 dated 1/13/2020 and replace it with the attached Special Provision Section 638 dated r3/24/2020.

7. Add Section 645 – Work Zone Traffic Control dated r3/24/2020 and make it a part of the Special Provisions.

8. Delete Section 660 dated 12/31/19 and replace it with the attached Section 660 dated r3/24/2020.

9. Delete Section 661 dated 1/24/2020 and replace it with the attached Section 661 dated r3/24/2020.

10. Add Section 695 – Portable Concrete Barrier, Inertial Barrier System and Lane-Shift Pavement Markings dated r3/24/2020 and make it a part of the Special Provisions.

11. Delete Section 761 dated 1/9/2020 and replace it with the attached Section 761 dated r3/24/2020.

12. Delete Section 770 dated 1/7/2020 and replace it with the attached Section 770 dated r3/24/2020.

D. PROPOSAL SCHEDULE

1. Delete Proposal Schedule pages P-11 through P-18 and replace them with the attached Proposal Schedule pages P-11 through P-19 dated r3/24/2020.

E. PLANS

1. Replace Plan Sheets No. ADD. 14, ADD. 20, 37, 39, 52 through 65, 67 through 115, 117 through 123, 126, 156, 157, and 164 with the attached revised Plan Sheets No. ADD. 14, ADD. 20, ADD. 37, ADD. 39, ADD. 52 through ADD. 65, ADD. 67 through ADD. 115, ADD. 117 through ADD. 123, ADD. 126, ADD. 156, ADD. 157, and ADD. 164.

2. Include new attached Plan Sheets No. ADD. 14S-1, ADD. 14S-2, ADD. 52S-1, ADD. 64S-1, ADD. 64S-2, ADD. 64S-3, ADD. 64S-4, ADD. 64S-5, ADD.6 64S-6, and ADD. 64S-7.

The following is provided for information.

F. ANSWERS TO QUESTIONS FROM PROSPECTIVE BIDDER

1. Attached are RFI's and responses for your information.

Please acknowledge receipt of this Addendum No. 3 by recording the date of its receipt in the space provided on page P-4 of the Proposal.

JADE T. BUTAY
Director of Transportation

NOTICE TO BIDDERS
(Chapter 103D, HRS)

The receiving of SEALED BIDS for Fort Barrette Road Operational Improvements, Roosevelt Avenue to Farrington Highway, District of Ewa, Island of Oahu, Project No. 901A-01-19, scheduled for 2:00 P.M., April 3, 2020, **will be received at the Contracts Office, Department of Transportation, 869 Punchbowl Street, Room 105, Honolulu, Hawaii 96813**, and is HEREBY POSTPONED until **2:00 P.M., WEDNESDAY, April 29, 2020**, at which time and place they will be publicly opened and read.

ATTENTION: Due to the impacts of COVID 19, bid submissions will be accepted by the Contracts Office for drop off in the lobby, DOT Aliiaimoku Hale, between the hours of 1:00 p.m. to 2:00 p.m., HST, Monday through Friday, excluding holidays. Bidders shall allow enough time to mail or courier their bids to meet the said due date and time. If the bidder chooses to deliver their bid by United States Postal Service (USPS), please be advised the USPS does not deliver directly to the State of Hawaii, DOT, Contracts Office, but to a central mailroom before final delivery to the Contracts Office. This may cause a delay in receipt of bid(s) by the Contracts Office and the bid(s) may reach the Contracts Office after the said due date and time, resulting in automatic rejection and return of bid. The DOT shall not be responsible for bids not received by the said due date and time due to mail or courier delivery delays. Electronic bids shall not be accepted. Bid envelopes shall be clearly marked "SEALED BID" with complete mailing address to the DOT, Contracts Office. Bids will be opened and read in the lobby of the DOT Aliiaimoku Hale promptly at said time. All bids will be scanned and emailed to all bidders within 24 hours of bid opening.

JADE T. BUTAY
Director of Transportation

TABLE OF CONTENTS

DIVISION 600 - INCIDENTAL CONSTRUCTION		
Section	**Description**	**Pages**
604	Manholes, Inlets and Catch Basins	604-1a
606	Guardrail	606-1a
612	Grouted Rubble Paving	612-1a
621	Enhanced Vehicle Classification Traffic Counting System	621-1a – 621-19a
623	Traffic Signal System	623-1a – 623-4a
626	Manholes and Valve Boxes for Water and Sewer Systems	626-1a
627	Pathway Lighting System	627-1a – 627-7a
629	Pavement Markings	629-1a – 629-13a
631	Traffic Control, Regulatory, Warning, and Miscellaneous Signs	631-1a – 631-2a
632	Markers	632-1a
634	Portland Cement Concrete Sidewalks	634-1a
638	Portland Cement Concrete Curb and Gutter	638-1a – 638-2a
641	Hydro-Mulch Seeding	641-1a
645	Work Zone Traffic Control	645-1a – 645-3a
650	Curb Ramps	650-1a
660	Railroad Signal System	660-1a – 660-57a
661	Railroad Track Construction	661-1a – 661-50a
694	Longitudinal Channelizing Curb System	694-1a – 694-2a
699	Mobilization	699-1a

DIVISION 700 - MATERIALS		
Section	**Description**	**Pages**
702	Bituminous Materials	702-1a
750	Traffic Control Sign and Marker Materials	750-1a – 750-2a
755	Pavement Marking Materials	755-1a
761	Light Emitting Diode (LED) Pathway Lighting Systems Materials	761-1a – 761-6a
770	Traffic Signal Materials	770-1a – 770-9a

Requirements of Chapter 104, HRS
Wages and Hours of Employees on Public Works Law

Proposal Title Page

Proposal ……..…… P-1 – P-10
Proposal Schedule ……..……. P-11 – P-19

END OF TABLE OF CONTENTS

Amend **Section 209 - TEMPORARY WATER POLLUTION, DUST, AND EROSION CONTROL** to read as follows:

"SECTION 209 - TEMPORARY WATER POLLUTION, DUST, AND EROSION CONTROL

209.01 Description. This section describes the following:

(A) Including detailed plans, diagrams, and written Site-Specific Best Management Practices (BMP); constructing, maintaining, and repairing temporary water pollution, dust, and erosion control measures at the project site, including local material sources, work areas and haul roads; removing and disposing hazardous wastes; control of fugitive dust (defined as uncontrolled emission of solid airborne particulate matter from any source other than combustion); and complying with applicable State and Federal permit conditions.

(B) Work associated with construction stormwater, dewatering, and hydrotesting activities and complying with conditions of the National Pollutant Discharge Elimination System (NPDES) permit(s) authorizing discharges associated with construction stormwater, dewatering, and hydrotesting activities.

(C) Potential pollutant identification and mitigation measures are listed in Appendix A for use in the development of the Contractor's Site-Specific BMP.

Requirements of this section also apply to construction support activities including concrete or asphalt batch plants, rock crushing plants, equipment staging yards/areas, material storage areas, excavated material disposal areas, and borrow areas located outside the State Right-of-Way. For areas serving multiple construction projects, or operating beyond the completion of the construction project in which it supports, the Contractor shall be responsible for securing the necessary permits, clearances, and documents, and following the conditions of the permits and clearances, at no cost to the State.

209.02 Materials. Comply with applicable materials described in Chapters 2 and 3 of the current HDOT "Construction Best Management Practices Field Manual". In addition, the materials shall comply with the following:

(A) Grass. Grass shall be a quick growing species such as rye grass, Italian rye grass, or cereal grasses. Grass shall be suitable to the area and provide a temporary cover that will not compete later with permanent cover. Alternative grasses are allowable if acceptable to the Engineer.

(B) Fertilizer and Soil Conditioners. Fertilizer and soil conditioners shall be a standard commercial grade acceptable to the Engineer. Fertilizer shall conform to Subsection 619.02(H)(1) - Commercial Fertilizer.

(C) Hydro-mulching. Hydro-mulching used as a temporary vegetative stabilization measure shall consist of materials in Subsections 209.02(A) - Grass, and 209.02(B) – Fertilizer and Soil Conditioners. Mulches shall be recycled materials including bagasse, hay, straw, wood cellulose bark, wood chips, or other material acceptable to the Engineer. Mulches shall be clean and free of noxious weeds and deleterious materials. Potable water shall meet the requirements of Subsection 712.01 - Water. Submit alternate sources of irrigation water for the Engineer's acceptance if deviating from 712.01 - Water. Installation and other requirements shall be in accordance with portions of Section 641- Hydro-Mulch Seeding including 641.02(D) - Soil and Mulch Tackifier, 641.03(A) – Seeding, and 641.03(B) - Planting Period. Install non-vegetative controls including mulch or rolled erosion control products while the vegetation is being established. Water and fertilize grass. Apply fertilizer as recommended by the manufacturer. Replace grass the Engineer considers unsuitable or sick. Remove and dispose of trash and debris. Remove invasive species. Mow as needed to prevent site or signage obstructions, fire hazard, or nuisance to the public. Do not remove down stream sediment control measures until the vegetation is uniformly established, including no large bare areas, and provides 70 percent of the density of pre-disturbance vegetation. Temporary vegetative stabilization shall not be used longer than one year.

(D) Silt Fences. Comply with ASTM D6462, Standard Practice for Silt Fence Installation.

Alternative materials or methods to control, prevent, remove and dispose pollution are allowable if acceptable to the Engineer.

209.03 Construction.

(A) Preconstruction Requirements.

(1) Water Pollution, Dust, and Erosion Control Meeting. Schedule a water pollution, dust, and erosion control meeting with the Engineer after Site-Specific BMP is accepted in writing by the Engineer. Meeting shall be scheduled a minimum of 14 calendar days prior to the Start Work Date. Discuss sequence of work, plans and proposals for water pollution, dust, and erosion control.

(2) Water Pollution, Dust, and Erosion Control Submittals. Submit a Site-Specific BMP Plan within 30 calendar days of contract execution. Submission of complete and acceptable Site-Specific BMP Plan is the sole responsibility of the Contractor and additional contract

time will not be issued for delays due to incompleteness. Include the following:

(a) Written description of activities to minimize water pollution and soil erosion into State waters, drainage or sewer systems. BMP shall include the following:

1. An identification of potential pollutants and their sources.

2. A list of all materials and heavy equipment to be used during construction.

3. Descriptions of the methods and devices used to minimize the discharge of pollutants into State waters, drainage or sewer systems.

4. Details of the procedures used for the maintenance and subsequent removal of any erosion or siltation control devices.

5. Methods of removing and disposing hazardous wastes encountered or generated during construction.

6. Methods of removing and disposing concrete and asphalt pavement cutting slurry, concrete curing water, and hydrodemolition water.

7. Spill Control and Prevention and Emergency Spill Response Plan.

8. Fugitive dust control, including dust from grinding, sweeping, or brooming off operations or combination thereof.

9. Methods of storing and handling of oils, paints and other products used for the project.

10. Material storage and handling areas, and other staging areas.

11. Concrete truck washouts.

12. Concrete waste control.

13. Fueling and maintenance of vehicles and other equipment.

14. Tracking of sediment offsite from project entries and exits.

15. Litter management.

16. Toilet facilities.

17. Other factors that may cause water pollution, dust and erosion control.

(b) Provide plans indicating location of water pollution, dust and erosion control devices; provide plans and details of BMPs to be installed or utilized; show areas of soil disturbance in cut and fill, indicate areas used for construction staging and storage including items (1) through (17) above, storage of aggregate (indicate type of aggregate), asphalt cold mix, soil or solid waste, equipment and vehicle parking, and show areas where vegetative practices are to be implemented. Indicate intended drainage pattern on plans. Include flow arrows. Include separate drawing for each phase of construction that alters drainage patterns. Indicate approximate date when device will be installed and removed.

(c) Construction schedule.

(d) Name(s) of specific individual(s) designated responsible for water pollution, dust, and erosion controls on the project site. Include home, cellular, and business telephone numbers, fax numbers, and e-mail addresses.

(e) Description of fill material to be used.

(f) For projects with an NPDES Permit for Construction Activities, submit information to address all sections in the Storm Water Pollution Prevention Plan (SWPPP).

(g) For projects with an NPDES Permit, information required for compliance with the conditions of the Notice of General Permit Coverage (NGPC)/NPDES Permit.

(h) Site-Specific BMP Review Checklist. The checklist may be downloaded from HDOT's Stormwater Management website at http://stormwaterhawaii.com.

Date and sign Site-Specific BMP Plan. Keep accepted copy on site or at an accessible location so that it can be made

available at the time of an on-site inspection or upon request by the Engineer, HDOT Third-Party Inspector, and/or DOH/EPA Representative. Amendments to the Site-Specific BMP Plan shall be included with original Site-Specific BMP Plan. Modify SWPPP if necessary to conform to revisions. Include date of installation and removal of Site-Specific BMP measures. Obtain written acceptance by the Engineer before implementing revised Site-Specific BMPs in the field.

Follow the guidelines in the current HDOT "Construction Best Management Practices Field Manual", in developing, installing, and maintaining Site-Specific BMPs for all projects. For any conflicting requirements between the Manual and applicable bid documents, the applicable bid documents will govern. Should a requirement not be clearly described within the applicable bid documents, notify the Engineer immediately for interpretation. For the purposes of clarification "applicable bid documents" include the construction plans, standard specifications, special provisions, Permits, and the SWPPP when applicable.

Follow Honolulu's City and County "Rules for Soil Erosion Standards and Guidelines" for all projects on Oahu. Use respective Soil Erosion Guidelines for Maui, Kauai and Hawaii projects.

(B) Construction Requirements. Do not begin work until submittals detailed in Subsection 209.03(A)(2) - Water Pollution, Dust, and Erosion Control Submittals are completed and accepted in writing by the Engineer.

Install, maintain, monitor, repair and replace site-specific BMP measures, such as for water pollution, dust and erosion control; installation, monitoring, and operation of hydrotesting activities; removal and disposal of hazardous waste indicated on plans, concrete cutting slurry, concrete curing water; or hydrodemolition water. Site-Specific BMP measures shall be in place, functional and accepted by HDOT personnel prior to initiating any ground disturbing activities.

If necessary, furnish and install rain gage in a secure location prior to field work including installation of site-specific BMP. Provide rain gage with a tolerance of at least 0.05 inches of rainfall. Install rain gage on project site in an area that will not deter rainfall from entering the gate opening. Do not install in a location where rain water may splash into rain gage. The rain gage installation shall be stable and plumbed. Maintain rain gage and replace rain gage that is stolen, does not function properly or accurately, is worn out, or needs to be relocated. Do not begin field work until rain gage is installed and Site-Specific BMPs are in place. Rain gage data logs shall be

readily available. Submit rain gage data logs weekly to the Engineer.

Address all comments received from the Engineer.

Modify and resubmit plans and construction schedules to correct conditions that develop during construction which were unforeseen during the design and pre-construction stages.

Coordinate temporary control provisions with permanent control features throughout the construction and post-construction period.

Limit maximum surface area of earth material exposed at any time to 300,000 square feet. Do not expose or disturb surface area of earth material (including clearing and grubbing) until BMP measures are installed and accepted in writing by the Engineer. Protect temporarily or permanently disturbed soil surface from rainfall impact, runoff and wind before end of the work day.

Immediately initiate stabilizing exposed soil areas upon completion of earth disturbing activities for areas permanently or temporarily ceased on any portion of the site. Earth-disturbing activities have permanently ceased when clearing and excavation within any area of the construction site that will not include permanent structures has been completed. Earth-disturbing activities have temporarily ceased when clearing, grading, and excavation within any area of the site that will not include permanent structures will not resume for a period of 14 or more calendar days, but such activities will resume in the future. The term “immediately” is used in this section to define the deadline for initiating stabilization measures. “Immediately” means as soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased.

For projects with an NPDES Permit for Construction activities:

1) For construction areas discharging into waters not impaired for nutrients or sediments, complete initial stabilization within 14 calendar days after the temporary or permanent cessation of earth-disturbing activities.

2) For construction areas discharging into nutrient or sediment impaired waters, complete initial stabilization within 7 calendar days after the temporary or permanent cessation of earth-disturbing activities.

For projects without an NPDES Permit for Construction activities, complete initial stabilization within 14 calendar days after the temporary or permanent cessation of earth-disturbing activities.

Any of the following types of activities constitutes initiation of stabilization:

(1) Prepping the soil for vegetative or non-vegetative stabilization;

(2) Applying mulch or other non-vegetative product to the exposed area;

(3) Seeding or planting the exposed area;

(4) Starting any of the activities in items (1) – (3) above on a portion of the area to be stabilized, but not on the entire area; and

(5) Finalizing arrangements to have stabilization product fully installed in compliance with the deadline for completing initial stabilization activities.

Any of the following types of activities constitutes completion of initial stabilization activities:

(1) For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and/or

(2) For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

If the Contractor is unable to meet the deadlines above due to circumstances beyond the Contractor's control, and the Contractor is using vegetative cover for temporary or permanent stabilization, the Contractor may comply with the following stabilization deadlines instead as agreed to by the Engineer:

(1) Immediately initiate, and complete within the timeframe shown above, the installation of temporary non-vegetative stabilization measures to prevent erosion;

(2) Complete all soil conditioning, seeding, watering or irrigation installation, mulching, and other required activities related to the planting and initial establishment of vegetation as soon as conditions or circumstances allow it on the site; and

(3) Notify and provide documentation to the Engineer the circumstances that prevent the Contractor from meeting the deadlines above for stabilization and the schedule the Contractor will follow for initiating and completing initial stabilization and as agreed to by the Engineer.

Follow the applicable requirements of the specifications and special provisions including Section 619 - Planting and Section 641 - Hydro-mulch Seeding.

Immediately after seeding or planting the area to be vegetatively stabilized, to the extent necessary to prevent erosion on the seeded or planted area, select, design, and install non-vegetative erosion controls that provide cover (e.g., mulch, rolled erosion control products) to the area while vegetation is becoming established.

Protect exposed or disturbed surface area with mulches, grass seeds or hydromulch. Spray mulches at a rate of 2,000 pounds per acre. Add tackifier to mix at a rate of 85 pounds per acre. Apply grass seeds at a rate of 125 pounds per acre. For hydromulch, use the ingredients and rates required for mulches and grass seeds. Submit recommendations from a licensed Landscape Architect when deviating from the application rates above.

Apply fertilizer to mulches, grass seed or hydromulch per manufacturer's recommendations. Submit recommendations from a licensed Landscape Architect when deviating from the manufacturer's recommendations.

Install velocity dissipation measures when exposing erodible surfaces greater than 15 feet in height.

BMP measures shall be in place and operational at the end of work day or as required by Section 209.03(B) – Construction Requirements.

Install and maintain either or both stabilized construction entrances and wheel washes to minimize tracking of dirt and mud onto roadways. Restrict traffic to stabilized construction areas only. Clean dirt, mud, or other material tracked onto the road, sidewalk, or other paved area by the end of the same day in which the track-out occurs. Modify stabilized construction entrances to prevent mud from being tracked onto road. Stabilize entire access roads if necessary.

Chemicals may be used as soil stabilizers for either or both erosion and dust control if acceptable to the Engineer.

Provide temporary slope drains of rigid or flexible conduits to carry runoff from cuts and embankments. Provide portable flume at the entrance. Shorten or extend temporary slope drains to ensure proper function.

Protect ditches, channels, and other drainageways leading away from cuts and fills at all times by either:

(1) Hydro-mulching the lower region of embankments in the immediate area.

(2) Installing check dams and siltation control devices.

(3) Other methods acceptable to the Engineer.

Provide for controlled discharge of waters impounded, directed, or controlled by project activities or erosion control measures.

Cover exposed surface of materials completely with tarpaulin or similar device when transporting aggregate, soil, excavated material or material that may be source of fugitive dust.

Cleanup and remove any pollutant that can be attributed to the Contractor.

Install or modify Site-Specific BMP measures due to change in the Contractor's means and methods, or for omitted condition that should have been allowed for in the accepted Site-Specific BMP or a Site-Specific BMP that replaces an accepted Site-Specific BMP that is not satisfactorily performing. Modifications to Site-Specific BMP measures shall be accepted in writing by the Engineer prior to implementation.

Properly maintain all Site-Specific BMP measures.

For projects with an NPDES Permit for Construction Activities:

(1) For construction areas discharging into nutrient or sediment impaired waters, inspect, prepare a written report, and make repairs to BMP measures at the following intervals:

(a) Weekly.

(b) Within 24 hours of any rainfall of 0.25 inch or greater which occurs in a 24-hour period.

(c) When existing erosion control measures are damaged or not operating properly as required by Site-Specific BMP.

(2) For construction areas discharging to waters not impaired for nutrients or sediments, inspect, prepare a written report, and make repairs to BMP measures at the following intervals:

(a) Weekly.

(b) When existing erosion control measures are damaged or

not operating properly as required by Site-Specific BMP.

For projects without an NPDES Permit for Construction activities, inspect, prepare a written report, and make repairs to BMP measures at the following intervals:

(a) Weekly.

(b) When existing erosion control measures are damaged or not operating properly as required by Site-Specific BMP.

Temporarily remove, replace or relocate any Site-Specific BMP that must be removed, replaced or relocated due to potential or actual flooding, or potential danger or damage to project or public.

Maintain records of inspections of Site-Specific BMP work. Keep continuous records for duration of the project. Submit copy of Inspection Report to the Engineer within 24 hours after each inspection.

The Contractor's designated representative specified in Subsection 209.03(A)(2)(d) shall address any Site-Specific BMP deficiencies brought up by the Engineer immediately, including weekends and holidays, and complete work to fix the deficiencies by the close of the next work day if the problem does not require significant repair or replacement, or if the problem can be corrected through routine maintenance. Address any Site-Specific BMP deficiencies brought up by the State's Third-Party Inspector in the timeframe above or as specified in the Consent Decree or MS4 NPDES Permit, whichever is more stringent. The Consent Decree timeframe requirement applies statewide. The MS4 NPDES Permit only applies to Oahu. In this section, "immediately" means the Contractor shall take all reasonable measures to minimize or prevent discharge of pollutants until a permanent solution is installed and made operational. If a problem is identified at a time in the day in which it is too late to initiate repair, initiation of repair shall begin on the following work day. When installation of a new pollution prevention control or a significant repair is needed, complete installation or repair no later than seven calendar days from the time of notification/Contractor discovery. Notify the Engineer and document why it is infeasible to complete the installation or repair within seven calendar days and complete the work as soon as practicable and as agreed to by the Engineer. Address Site-Specific BMP deficiencies discovered by the Contractor within the timeframe above. The Contractor's failure to satisfactorily address these Site-Specific BMP deficiencies, the Engineer reserves the right to employ outside assistance or use the Engineer's own labor forces to provide necessary corrective measures. The Engineer will charge the Contractor such incurred costs plus any associated project engineering costs. The Engineer will make appropriate deductions from the Contractor's monthly progress estimate. Failure to apply Site-Specific BMP

measures may result in one or more of the following: assessment of liquidated damages, suspension, or cancellation of Contract with the Contractor being fully responsible for all additional costs incurred by the State.

(C) Discharges of Storm Water Associated with Construction Activities. If work includes disturbance of one acre or more, an NPDES Permit authorizing Discharges of Storm Water Associated with Construction Activity (CWB-NOI Form C) or Individual Permit authorizing storm water discharges associated with construction activity is required from the Department of Health Clean Water Branch (DOH-CWB).

Do not begin construction activities until all required conditions of the permit are met and submittals detailed in Subsection 209.03(A)(2) – Water Pollution, Dust, and Erosion Control Submittals are completed and accepted in writing by the Engineer.

(D) Discharges Associated with Hydrotesting Activities. If hydrotesting activities require effluent discharge into State waters or drainage systems, an NPDES Hydrotesting Waters Permit (CWB-NOI Form F) or Individual Permit authorizing discharges associated with hydrotesting from DOH-CWB is required from the DOH-CWB.

Do not begin hydrotesting activities until the DOH-CWB has issued an Individual NPDES Permit or Notice of General Permit Coverage (NGPC). Conduct Hydrotesting operations in accordance with the conditions of the permit or NGPC.

(E) Discharges Associated with Dewatering Activities. If dewatering activities require effluent discharge into State waters or drainage systems, an NPDES Dewatering Permit (CWB-NOI Form G) or Individual Permit authorizing discharges associated with dewatering from DOH-CWB is required from the DOH-CWB.

Do not begin dewatering activities until the DOH-CWB has issued an Individual NPDES Permit or Notice of General Permit Coverage (NGPC). Conduct dewatering operations in accordance with the conditions of the permit or NGPC.

(F) Solid Waste. Submit the Solid Waste Disclosure Form for Construction Sites to the Engineer within 30 calendar days of contract execution. Provide a copy of all the disposal receipts from the facility permitted by the Department of Health to receive solid waste to the Engineer monthly. This should also include documentation from any intermediary facility where solid waste is handled or processed, or as directed by the Engineer.

(G) Construction BMP Training. The Contractor's representative responsible for development of the Site-Specific BMP Plan and implementation of Site-Specific BMPs in the field shall attend the State's Construction Best Management Practices Training. The Contractor shall keep training logs updated and readily available.

(H) Hazardous Materials Mitigation for Site Work. Follow the requirements of Subsection 107.16 – Contaminated or Hazardous Items and Material; Regulated Items and Materials; Waste including having certified Hazardous Materials Company dispose of material. Comply with applicable sections of the current HDOT "Construction Best Management Practices Field Manual" and SWPPP. Payment under this section shall only apply to existing hazardous materials on site.

209.04 Measurement.

(A) Installation, maintenance, monitoring, and removal of BMP will be paid on a lump sum basis. Measurement for payment will not apply.

(B) The Engineer will only measure additional water pollution, dust and erosion control required and requested by the Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

(C) The Engineer will only measure hazardous materials mitigation required and requested by the Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

209.05 Payment. The Engineer will pay for accepted pay items listed below at contract price per pay unit, as shown in the proposal schedule. Payment will be full compensation for work prescribed in this section and contract documents.

The Engineer will pay for each of the following pay items when included in proposal schedule:

Pay Item	**Pay Unit**
Installation, Maintenance, Monitoring, and Removal of BMP	Lump Sum
Additional Water Pollution, Dust, and Erosion Control	Force Account
Hazardous Materials Mitigation	Force Account

An estimated amount for force account is allocated in proposal schedule under 'Additional Water Pollution, Dust, and Erosion Control' and 'Hazardous Materials Mitigation,' but actual amount to be paid will be the sum shown on

accepted force account records, whether this sum be more or less than estimated amount allocated in proposal schedule. The Engineer will pay for BMP measures requested by the Engineer that are beyond scope of accepted Site-Specific BMP on a force account basis.

No progress payment will be authorized until the Engineer accepts in writing Site-Specific BMP or when the Contractor fails to maintain project site in accordance with accepted BMP.

For all citations or fines received by the Department for non-compliance, including compliance with NPDES Permit conditions, the Contractor shall reimburse State within 30 calendar days for full amount of outstanding cost State has incurred, or the Engineer will deduct cost from progress payment.

The Engineer will assess liquidated damages up to $27,500 per day for non-compliance of each BMP requirement and all other requirements in this section.

Appendix A

The following list identifies potential pollutant sources and corresponding BMPs used to mitigate the pollutants. Each BMP is referenced to the corresponding section of the current HDOT Construction Best Management Practices Field Manual or appropriate Supplemental Sheets. The Manual may be obtained from the HDOT Statewide Stormwater Management Program Website at *http://www.stormwaterhawaii.com/resources/contractors-and-consultants/* under Construction Best Management Practices Field Manual. Supplemental BMP sheets are located at *http://www.stormwaterhawaii.com/resources/contractors-and-consultants/storm-water-pollution-prevention-plan-swppp/* under Concrete Curing and Irrigation Water.

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Construction debris, green waste, general litter	• *Separate contaminated clean up materials from construction and demolition (C&D) wastes.* • *Provide waste containers (e.g., dumpster or trash receptacle) of sufficient size and number to contain construction and domestic wastes.* • *Inspect construction waste and recycling areas regularly.* • *Schedule solid waste collection regularly.* • *Schedule recycling activities based on construction/demolition phases.* • *Empty waste containers weekly or when they are two-thirds full, whichever is sooner.* • *Do not allow containers to overflow. Clean up immediately if they do.* • *On work days, clean up and dispose of waste in designated waste containers.* • *See Solid Waste Management Section SM-6 for additional requirements.* • *Provide Storm Drain Inlet Protection and/or Perimeter Sediment Controls as applicable.*	*See Solid Waste Management Section SM-6. Protect Storm Drain Inlets SC-2, and Perimeter Sediment Controls where applicable.*
Materials associated with the operation and maintenance of equipment, such as oil, fuel, and hydraulic fluid leakage	• *Use off-site wash racks, repair and maintenance facilities, and fueling sites when practical.* • *Designate bermed wash area if cleaning on site is necessary.* • *Place drip pans or drop cloths under vehicles and equipment to absorb spills or leaks.* • *Provide an ample supply of readily available spill cleanup materials.* • *Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly.* • *Do not clean surfaces or spills by hosing the area down.* • *Eliminate the source of the spill to prevent a discharge or a continuation of an ongoing discharge.* • *Inspect on-site vehicles and equipment regularly and immediately repair leaks.* • *Regularly inspect fueling areas and storage tanks.*	*See Vehicle and Equipment Cleaning, Maintenance, and Refueling, Sections SM-11, SM-12, and SM-13, and Material Delivery, Storage and Material Use Sections SM-2 and SM-3, and Spill Prevention and Control SM-10.*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	• *Train employees on proper maintenance and spill practices and procedures and fueling and cleanup procedures.* • *Store diesel fuel, oil, hydraulic fluid, or other petroleum products or other chemicals in water-tight containers and provide cover or secondary containment.* • *Do not remove original product labels and comply with manufacturer's labels for proper disposal.* • *Dispose of containers only after all the product has been used.* • *Dispose of or recycle oil or oily wastes according to Federal, State, and Local requirements.* • *Store soaps, detergents, or solvents under cover or other means to prevent contact with rainwater.* • *See Vehicle and Equipment Cleaning, Maintenance, and Refueling, Sections SM-11, SM-12, and SM-13 and Material Use Section SM-3 for additional requirements.*	

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Soil erosion from the disturbed areas	• *Provide Soil Stabilization, Slope Protection, Storm Drain Inlet Protection SC-2, Perimeter Controls and Sediment Barriers, Sediment Basins and Detention Ponds, Check Dams SC-9 ,Level Spreader SC-10, Paving Operations SM-19, Construction Road Stabilization EC-1, Controlling Storm Water Flowing Onto and Through the Project, Post-Construction BMPs, and Non-Structural BMPs (Employee Training SM-1, Scheduling SM-14, Location of Potential Sources of Sediment SM-15, Preservation of Existing Vegetation SM-16) .* • *Delineate, and clearly mark off, with flags, tape, or other similar marking device all natural buffer areas defined in the SWPPP.* • *Preserve native topsoil where practicable.* • *In areas where vegetative stabilization will occur, restrict vehicle/equipment use in areas to avoid soil compaction or condition soil to promote vegetative growth.* • *For Storm Drain Inlet Protection, clean, or remove and replace, the protection measures as sediment accumulates, the filter becomes clogged, and/or performance is compromised.* • *Where there is evidence of sediment accumulation adjacent to the inlet protection measure, remove the deposited sediment by the end of the same day in which it is found or by the end of the following work day if removal by the same day is not feasible.* • *Sediment basins shall be designed and maintained in accordance with HAR 11-55.* • *Minimize disturbance on steep slopes (Greater than 15% in grade).* • *If disturbance of steep slopes are unavoidable, phase disturbances and use stabilization techniques*	*Soil Stabilization* 1. *SM-21 Topsoil Management* 2. *EC-5 Seeding and Planting* 3. *EC-6 Mulching* 4. *EC-7 Geotextiles and Mats* *Slope Protection* 1. *EC-5 Seeding and Planting* 2. *EC-6 Mulching* 3. *EC-7 Geotextiles and Mats* 4. *EC-9 Slope Roughening, Terracing, and Rounding* 5. *SC-11 Slope Drains and Subsurface Drains* 6. *SC-12 Top and Toe of Slope Diversion Ditches*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	designed for steep grades. • *For temporary drains and swales use velocity dissipation devices within and at the outlet to minimize erosive flow velocities.*	*and Berms* *SC-2 Storm Drain Inlet Protection* *Perimeter Controls and Sediment Barriers* *1. SC-1 Silt Fence* *2. SC-5 Vegetated Filter Strips and Buffers* *3. SC-8 Compost Filter Berm* *4. SC-13 Sandbag Barrier* *5. SC-14 Brush or Rock Filter* *Sediment Basins and Detention Ponds* *1. SC-15 Sediment Trap* *2. SC-16 Sediment Basin* *SC-9 Check Dams* *SC-10 Level Spreader*

Pollutant Source	*Appropriate Site-Specific BMP to be Implemented*	*BMP Requirements*
		SM-19 Paving Operations *EC-1 Construction Road Stabilization* *Controlling Storm Water Flowing onto and Through the Project* 1. *EC-8 Run-On Diversion* 2. *SC-6 Earth Dike* 3. *SC-7 Temporary Drains and Swales* *Post Construction BMPs* 1. *EC-4 Flared Culvert End Sections* 2. *SC-3 Rip-Rap and Gabion Inflow Protection* 3. *SC-4 Outlet Protection and Velocity Dissipation*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
		Devices *4. SM-21 Topsoil Management* *Non-Structural BMPs* *1. SM-1 Employee Training* *2. SM-14 Scheduling* *3. SM-15 Location of Potential Sources of Sediment* *4. SM-16 Preservation of Existing Vegetation*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Sediment from soil stockpiles	• *Locate stockpiles a minimum of 50 feet or as far as practicable from concentrated runoff or outside of any natural buffers identified on the SWPPP.* • *Place bagged materials on pallets and under cover.* • *Provide physical diversion to protect stockpiles from concentrated runoff.* • *Cover stockpiles with plastic or comparable material when practicable.* • *Place silt fence, fiber filtration tubes, or straw wattles around stockpiles.* • *Do not hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any storm water conveyance (unless connected to a sediment basin, sediment trap, or similarly effective control), storm drain inlet, or state water.* • *Unless infeasible, contain and securely protect stockpiles from the wind.* • *Provide Storm Drain Inlet Protection and/or Perimeter Sediment Controls as applicable.* • *See Protection of Stockpiles Section SM-4 for additional requirements.*	*See Protection of Stockpiles Section SM-4. Protect Storm Drain Inlets SC-2, and Perimeter Sediment Controls where applicable.*
Emulsified asphalt or prime/tack coat	• *Provide training for employees and contractors on proper material delivery and storage practices and procedures.* • *Restrict paving operations during wet weather to prevent paving materials from being discharged.* • *Use asphalt emulsions such as prime coat when possible.* • *Protect drain inlet structures and manholes during application of tack coat, seal coat, slurry seal, and fog seal.* • *Keep ample supplies of drip pans and absorbent materials on site.* • *Inspect inlet protection devices.* • *See Material Delivery and Storage Section SM-2 and Paving Operations Section SM-19 for additional requirements.* • *Provide Storm Drain Inlet Protection and/or*	*See Material Delivery and Storage Section SM-2 and Material Use Section SM-3, Paving Operations Section SM-19, Protect Storm Drain Inlets SC-2, and Perimeter Sediment Controls where*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	Perimeter Sediment Controls as applicable.	*applicable.*
Materials associated with painting, such as paint and paint wash solvent	• *Hazardous chemicals shall be well-labeled and stored in original containers.* • *Keep ample supply of cleanup materials on site.* • *Dispose container only after all of the product has been used.* • *Remove as much paint from brushes on painted surface.* • *Rinse from water-based paints shall be discharged into the sanitary sewer system where possible. If not, direct all washwater into a leak-proof container or leak-proof pit. The container or pit must be designed so that no overflows can occur due to inadequate sizing or precipitation.* • *Locate on-site wash area a minimum of 50 feet away or as far as practicable from storm drain inlets, open drainage facilities, or water bodies.* • *. Do not dump liquid wastes into the storm drainage system.* • *Filter and re-use solvents and thinners.* • *Dispose of oil-based paints and residue as a hazardous waste.* • *Ensure collection, removal, and disposal of hazardous waste complies with regulations.* • *Immediately clean up spills and leaks.* • *Properly store paints, solvents, and epoxy compounds.* • *Properly store and dispose waste materials generated from painting and structure repair and construction activities.* • *Mix paints in a covered and contained area when possible to minimize adverse impacts from spills.* • *Do not apply traffic paint or thermoplastic if rain is forecasted.* • *See Material Delivery and Storage Section SM-2, Material Use SM-3, Waste Management, Hazardous Waste Management Section SM-9, Waste Management, Spill Prevention and Control Section SM-10, and Structure Construction and Painting Section SM-20 for additional requirements.*	*See Material Delivery and Storage Section SM-2, Material Use Section SM-3, Hazardous Waste Management Section SM-9, Waste Management, Spill Prevention and Control Section SM-10, and Structure Construction and Painting Section SM-20, Protect Storm Drain Inlets SC-2, and Perimeter Sediment Controls where applicable.*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	• *Provide Storm Drain Inlet Protection and/or Perimeter Sediment Controls as applicable.*	
Industrial chemicals, fertilizers, and/or pesticides	• *Hazardous chemicals shall be well-labeled and stored in original containers.* • *Keep ample supply of cleanup materials on site.* • *Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly.* • *Do not clean surfaces or spills by hosing the area down.* • *Eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge.* • *Dispose container only after all of the product has been used.* • *Retain a complete set of material safety data sheets on site.* • *Store industrial chemicals in water-tight containers and provide either cover or secondary containment.* • *Provide cover when storing fertilizers or pesticides to prevent these chemicals from coming into contact with rainwater.* • *Restrict amount of pesticide prepared to quantity necessary for the current application.* • *Do not apply fertilizers or pesticides during or just before a rain event.* • *Do not apply to stormwater conveyance channels with flowing water.* • *Comply with fertilizer and pesticide manufacturer's recommended usage instructions.* • *Follow federal, state, and local laws regarding fertilizer application.* • *Do not dispose of toxic liquid wastes (solvents, used oils, and paints) or chemicals (additives, acids, and curing compounds) in dumpsters allocated for construction debris.* • *Ensure collection, removal, and disposal of hazardous waste complies with regulations. Hazardous waste that cannot be reused or recycled shall be disposed of by a licensed hazardous waste hauler.* • *See Material Delivery and Storage Section SM2,*	*See Material Delivery and Storage Section SM-2, Material Use Section SM-3, and Hazardous Waste Management Section SM-9, and Spill Prevention and Control SM-10*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	Material Use SM-3, and Waste Management, Hazardous Waste Management Section SM-9 for additional requirements.	
Hazardous waste (Batteries, Solvents, Treated Lumber, etc.)	• *Do not dispose of toxic materials in dumpsters allocated for construction debris.* • *Ensure collection, removal, and disposal of hazardous waste complies with regulations.* • *Hazardous waste that cannot be reused or recycled shall be disposed of by a licensed hazardous waste hauler.* • *Segregate and recycle wastes from vehicle/equipment maintenance activities such as used oil or oil filters, greases, cleaning solutions, antifreeze, automotive batteries, and hydraulic and transmission fluids.* • *Store waste in sealed containers, which are constructed of suitable materials to prevent leakage and corrosion, and which are labeled in accordance with applicable Resource Conservation and Recovery Act (RCRA) requirements and all other applicable federal, state, and local requirements.* • *All containers stored outside shall be kept away from surface waters and within appropriately-sized secondary containment (e.g., spill berms, decks, spill containment pallets). Provide cover if possible.* • *Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly.* • *Do not clean surfaces or spills by hosing the area down.* • *Eliminate the source of the spill to prevent a discharge or a continuation of an ongoing discharge.* • *Ensure collection, removal, and disposal of hazardous waste complies with manufacturer's recommendations and is in compliance with federal, state, and local requirements.* • *See Hazardous Waste Management Section SM-9 and Vehicle and Equipment Management, Vehicle and Equipment Maintenance SM-12 for additional requirements.*	*See Hazardous Waste Management Section SM-9 and Vehicle and Equipment Maintenance SM-12*
Metals and	• *Inspect construction waste and recycling areas*	*See Solid*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Building Materials	*regularly.* • *Schedule solid waste collection regularly.* • *If building materials or metals are stored on site (such as rebar or galvanized poles) store under cover under tarps or in containers.* • *Minimize the amount of material stored on site.* • *Do not stockpile uncovered metals or other building materials in close proximity to discharge points.* • *See Solid Waste Management Section SM-6 for additional requirements.*	*Waste Management Section SM-6*
Contaminated Soil	• *See Waste Management, Contaminated Soil Management Section SM-8 and/or Hazardous Waste Management Section SM-9 for additional requirements.* • *At minimum contain contaminated material soil by surrounding with impermeable lined berms or cover exposed contaminated material with plastic sheets.*	*See Waste Management, Contaminated Soil Management Section SM-8 and/or Hazardous Waste Management Section SM-9*
Dust Control Water	• *Do not over spray water for dust control purposes which will result in runoff from the area.* • *Apply water as conditions require.* • *Washing down of debris or dirt into drainage, sewage systems, or State waters is not allowed.* • *See Dust Control Section SM-18 for additional requirements.*	*See Dust Control Section SM-18*
Concrete Truck Wash Water	• *Disposal of concrete truck wash water via percolation is prohibited.* • *Wash concrete-coated vehicles or equipment off-site or in the designated wash area.* • *Locate on-site wash area a minimum of 50 feet*	*See Waste Management, Concrete Waste Management*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	away or as far as practicable from storm drain inlets, open drainage facilities, or water bodies. • *Runoff from the on-site concrete wash area shall be contained in a temporary pit or level bermed area where the concrete can set.* • *Design the area so that no overflow can occur due to inadequate wash area sizing or precipitation.* • *The temporary pit shall be lined with plastic to prevent seepage of wash water into the ground.* • *Allow wash water to evaporate or collect wash water and all concrete debris in a concrete washout system bin.* • *Do not dump liquid wastes into storm drainage system.* • *Dispose of liquid and solid concrete wastes in compliance with federal, state, and local standards.* • *See Waste Management, Concrete Waste Management Section SM-5 for additional requirements.*	*Section SM-5*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Sediment Track-Out	• *Include Stabilized Construction Entrance at all points that exit onto paved roads.* • *A sediment trapping device is required if a wash rack is used in conjunction with the stabilized construction entrance/exit.* • *The pavement shall not be cleaned by washing down the street.* • *If sweeping is ineffective or it is necessary to wash the streets, wash water must be contained either by construction of a sump, diverting the water to an acceptable disposal area, or vacuuming the wash water.* • *Use BMPs for adjacent drainage structures.* • *Remove sediment tracked onto the street by the end of the day in which the track-out occurs.* • *Restrict vehicle use to properly designated exit points.* • *Include additional BMPs which remove sediment prior to exit when minimum dimensions can not be met.* • *See Stabilized Construction Entrance Section EC-2 for additional requirements.*	*See Stabilized Construction Entrance Section EC-2*
Irrigation Water	• *Consider irrigation requirements.* • *Where possible, avoid species which require irrigation.* • *Design timing and application methods of irrigation water to eliminate the runoff of excess irrigation water into the storm water drainage system.* • *See Seeding and Planting Section EC-5 and California Stormwater BMP Handbook SD-12 Efficient Irrigation at http://www.stormwaterhawaii.com/resources/contract*	*See Seeding and Planting Section EC-5 and California Stormwater BMP Handbook SD-12 Efficient Irrigation*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
	ors-and-consultants/storm-water-pollution-prevention-plan-swppp/ under Irrigation Water for additional requirements.	
Hydrotesting Effluent	• *If work includes removing, relocation or installing waterlines, and Contractor elects to flush waterline or discharge hydrotesting effluent into State waters or drainage systems, the Contractor shall prepare and obtain HDOT acceptance of a NOI/NPDES Permit Form F application for HDOT submittal to DOH CWB at least 30 calendar days prior to the start of Hydrotesting Activities if necessary. Site-Specific BMPs will be included in the NOI/NPDES Permit Form F submittal.*	*Site-Specific BMPs will be included in the NOI/NPDES Permit Form F submittal.*
Dewatering Effluent	• *If excavation or backfilling operations require dewatering, and Contractor elects to discharge dewatering effluent into State waters or existing drainage systems, Contractor shall prepare and obtain HDOT acceptance of a NOI/NPDES Permit Form G application for HDOT submittal to DOH CWB at least 30 calendar days prior to the start of Dewatering Activities if necessary. See Site Planning and General Practices, Dewatering Operations Section SM-17 for additional requirements.*	*See Dewatering Operations SM-17. Site-Specific BMPs will be included in the NOI/NPDES Permit Form G submittal.*
Saw-cutting Slurry	• *Saw cut slurry shall be removed from the site by vacuuming.* • *Provide storm drain protection during saw cutting. See Paving Operations Section SM-19 for additional requirements.* • *Provide Storm Drain Inlet Protection and/or Perimeter Sediment Controls as applicable.*	*See Paving Operations Section SM-19, Storm Drain Inlet Protection SC-2, Perimeter sediment controls where applicable*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Concrete Curing Water	• *Avoid overspraying of curing compounds.* • *Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.* • *See California Stormwater BMP Handbook NS-12 Concrete Curing at http://www.stormwaterhawaii.com/resources/contractors-and-consultants/storm-water-pollution-prevention-plan-swppp/ under Concrete Curing for additional requirements.*	*See California Stormwater BMP Handbook NS-12 Concrete Curing*
Plaster Waste Water	• *Direct all washwater into a leak-proof container or leak-proof pit. The container or pit must be designed so that no overflows can occur due to inadequate sizing or precipitation.* • *Locate on-site wash area a minimum of 50 feet away or as far as practicable from storm drain inlets, open drainage facilities, or water bodies.* • *Any significant residual materials remaining on the ground after the completion of construction shall be removed and properly disposed. If the residual materials contaminate the soil, then the contaminated soil shall also be removed and properly disposed of.* • *Plaster waste water shall not be allowed to flow into drainage structures or State waters.* • *See Material Delivery and Storage Section SM-2, Material Use SM-3, and Hazardous Waste Management Section SM-9 for additional requirements.*	*See Material Delivery and Storage Section SM-2, Material Use Section SM-3, and Hazardous Waste Management Section SM-9*

Pollutant Source	***Appropriate Site-Specific BMP to be Implemented***	***BMP Requirements***
Water-Jet Wash Water	• *For Water-Jet Wash Water used to clean vehicles, use off site wash racks or commercial washing facilities when practical.* • *See Vehicle and Equipment Cleaning Section SM-11 for additional information.* • *For Water-Jet Wash Water used to clean impervious surfaces, the runoff shall not be allowed to flow into drainage structures or State Waters.*	*See Vehicle and Equipment Cleaning Section SM-11*
Sanitary/Septic Waste	• *Locate Sanitary facilities in a convenient place away from drainage facilities.* • *Position sanitary facilities so they are secure and will not be tipped over or knocked down.* • *Wastewater shall not be discharged to the ground or buried.* • *A licensed service provider shall maintain sanitary/septic facilities in good working order.* • *Schedule regular waste collection by a licensed transporter.* • *See Sanitary/Septic Waste Section SM-7 for additional requirements.*	*See Sanitary/Septic Waste Section SM-7.*

"

END OF SECTION 209

SECTION 623 - TRAFFIC SIGNAL SYSTEM

Make the following amendments to said Section:

(l) Amend **623.01 Description** from lines 4 to 95 to read as follows:

"623.01 Description. This work includes furnishing labor, materials, tools, machinery, and equipment necessary to modify or install and construct an operating traffic signal system, including trenching, excavation and backfill, asphalt concrete pavement, aggregate base course, and aggregate subbase course, complete in place according to the contract.

The traffic signal system includes:

(1) trenching, structural excavating, backfilling, restoring work, and installing pullboxes;

(2) providing a complete and operating traffic signal system with controller, software, cabinet, auxiliary and support equipment, vehicle detectors, signal standards, traffic signals, interconnect, including interconnect fabric subduct, and appurtenances, signal head mounting, back plates for all mast arm mounted traffic signal heads, emergency vehicle preemption optical receivers, concrete foundations, cables, wiring, cleaning and adjusting signal heads, painting and restoration work;

(3) modifying traffic signal systems with software, vehicle detectors, Type II signal poles, traffic signals, interconnect, including interconnect fabric subduct, and appurtenances, signal head mounting, back plates for all mast arm mounted traffic signal heads, emergency vehicle preemption optical receivers, concrete foundations, removal of concrete foundations, cables, wiring, cleaning and adjusting signal heads, painting and restoration work;

(4) coordinating work and arranging for inspection of work with the Engineer and other agencies as required;

(5) installing the electrical service and metering facilities and paying for the electric company's charges;

(6) turning over to the HDOT a complete and operating traffic signal system according to the contract;

Furnish and install the incidental parts that the contract does not show and that are necessary to complete the traffic signal system as though such parts were in the contract.

Electrical equipment shall conform to the NEMA Standards and this contract. Material and workmanship shall conform to the "National Electric Code", (the Code); General Order Nos. 6 and 10 of the Hawaii Public Utilities Commission; the standards of the ASTM; the ANSI; Local Joint Pole Agreement; local power company rules; and local ordinances that may apply.

Definitions.

(1) Actuation - Operation of any type of detector.

(2) Clearance Interval - Length of time of display of signal indication following right-of-way interval.

(3) Detector for Traffic Actuation - Device that pedestrians or vehicles can register their presence with traffic-actuated controller.

(4) Extendible Portion - That part of green interval that follows initial portion.

(5) Extension Limit - Maximum time that traffic phase may retain right-of-way after actuation on another traffic phase, after timimg out initial portion.

(6) Flashing Feature - Feature incorporated to stop normal signal operation and cause flashing of predetermined combination of signal lights.

(7) Initial Portion - Part of green interval that is timed-out or separately controlled by traffic-actuated controller before extendible portion of interval takes effect.

(8) Interval - Several divisions of time cycle during which signal indications do not change.

(9) Interval Sequence - Order of appearance of signal indications during successive intervals of time cycle.

(10) Magnetic Vehicle Detector - Detector actuated by movement of vehicle passing through magnetic field.

(11) Major Street - Roadway approach or approaches at intersection normally carrying greater volume of vehicular traffic.

(12) Manual Operation - Operation of signal controller by hand-operated switch.

(13) Minimum Period - In semi-traffic-actuated controllers, shortest time for which right-of-way will be given to approaches not having detectors.

(14) Minor Movement Interval - Auxiliary phase added to controller phase (parent phase) and modified by auxiliary movement controller.

(15) Minor Street - Roadway approach or approaches at intersection normally carrying smaller volume of vehicular traffic.

(16) Non-Parent Phase - Controller phase not modified by auxiliary control unit.

(17) Parent Phase - Controller phase modified by auxiliary control unit.

(18) Passage Period - Time allowed for vehicle to travel at selected speed from detector to nearest point of conflicting traffic.

(19) Pedestrian Detector - Detector, usually of push-button type, installed near roadway and operated by hand.

(20) Pressure-Sensitive Vehicle Detector - Detector installed in roadway, actuated by pressure of vehicle passing over its surface.

(21) Pre-Timed Controller - Automatic control device for supervising operation of traffic control signals in accordance with pre-timed cycle and divisions.

(22) Recall Switch - Manually operated switch in actuated controller to provide for automatic return of right-of-way to street.

(23) Right-of-Way - Privilege of immediate use of highway.

(24) Signal Indication - Illumination of traffic signal lens or equivalent device, or of combination of several lenses or equivalent devices.

(25) Time Cycle - Number of seconds required for one complete revolution of timing dial or complete sequence of signal indications.

(26) Traffic-Actuated Controller - Digital control device for supervising operation of traffic control signals in accordance with varying demands of traffic as registered with controller by loop detectors or pedestrian push buttons.

(27) Traffic Phase - Part of cycle allocated to traffic movements receiving right-of-way or to combinations of traffic movements receiving right-of-way simultaneously during one or more intervals.

(28) Unit Extension - Minimum time, during extendible portion, for which right-of-way must remain on traffic phases following actuation on that phase, subject to extension limit"

(II) Amend **623.02 Materials** by adding the following after line 132:

"Pedestrian Signal Push Button with Integral Sign	770.12
Interconnect Fabric Subduct	770.13"

(III) Amend **Subsection 623.03(C)(7)** from lines 255 to 258 to read as follows:

"(7) Conduits. Lay polyvinyl chloride (PVC) conduits carefully in trenches prepared to receive conduits. Concrete encase PVC Schedule 40 conduits."

(IV) Amend **Section 623.05 – Payment** by adding the following pay item:

Pay Item	**Pay Unit**
"Traffic Signal Interconnect	Lump Sum"

END OF SECTION 623

Make this section a part of the Standard Specifications:

"SECTION 627 - PATHWAY LIGHTING SYSTEM

627.01 Description. This work includes furnishing and installing a shared-use pathway lighting system, power system for a new traffic signal controller and power system for a new railroad crossing controller in accordance to the contract.

This work includes furnishing and installing metal lamp posts with bases, luminaires, lamps, equipment enclosures, meter sockets, electrical apparatus, electrical conductors and conduits, fittings, concrete bases, pullboxes, and other materials necessary for operating and controlling the pathway lighting system and for providing power to the new traffic signal and railroad crossing controllers according to the contract.

Furnish and install all incidental parts necessary to complete the pathway lighting system and power for the traffic signal and railroad crossing controllers as though the contract showed such parts.

Electrical equipment shall conform to the NEMA Standards. Material and workmanship shall conform to the latest requirements of the "National Electrical Code," herein referred as the Code; General Order Nos. 6 and 10, of the Hawaii Public Utilities Commission; the standards of the ASTM; the ANSI; Local Joint Pole Agreement; local power company rules; and local ordinances that may apply.

627.02 Materials. Materials shall conform to the following:

Dark Green Enamel Paint	708.03
Pullboxes	712.06(B)
Conduits	712.27
Light Poles	761.01A
Luminaires for Pathway Lighting	761.02
Cables and Wires	761.03
Disconnect and Protective Devices	761.04
Waterproof Connectors for Pathway Lighting	761.05
Dimming Photoelectric Control Unit	761.06

Concrete shall conform to Section 601 - Structural Concrete and shall be Class A.

Stainless steel anchor bolts, nuts, and steel plate covers shall be structural steel conforming to ASTM F593, F594 and A 36 respectively.

Materials will be subject to inspection. Failure of the Engineer to note faulty material or workmanship during construction will not relieve the responsibility of the Contractor for removing or replacing such materials and redoing the work at no cost to the State.

627.03 Construction Requirements.

(A) Equipment List and Drawings. Within 10 days following the award of the contract, the Contractor shall submit to the Engineer for acceptance 6 copies of a list of materials and equipment that the Contractor will incorporate in the work. The list shall include the name of the manufacturer, size and catalog number of the unit, detailed scale drawings and wiring diagrams of special equipment, and proposed deviations from the contract. If required, submit for acceptance samples of the material that the Contractor will use at no cost to the State.

Upon completion of the work, submit an 'As Built' plan showing in detail construction changes.

(B) Excavation and Backfill. Excavation and backfill shall conform to Section 204 - Excavation and Backfill for Miscellaneous Facilities.

Excavate carefully to prevent damage to pavements, sidewalks, and other improvements.

(C) Installation.

(1) Foundations. Concrete for foundations of metal lamp posts shall be Class B.

Locations of metal lamp posts shown in the contract are approximate only. The Engineer will decide the exact location in the field.

Forms shall be true to the lines and grades as accepted. Forms shall be rigid and securely braced in place. Place the conduit ends and anchor bolts in proper position, placed in proper

height, and held in place by a template until the concrete sets. Cure the concrete for not less than 72 hours.

(2) Metal Lamp Standards. Install each metal lamp standard on a concrete foundation. Set the shaft precisely vertical by adjusting the two nuts on each anchor bolt, while the luminaire shall be perpendicular to the pathway centerline.

(3) Luminaires. Install the pathway lighting luminaires on lamp posts with the vertical axis perpendicular to the pathway and longitudinal axis parallel to the pathway centerline.

(4) Circuits. Encase the cables installed underground in conduits or other accepted encasement.

Before installing the wires and cables in conduits, pull a wire brush, swab and mandrel through each conduit for the removal of extraneous matter and verification of the absence of obstructions and debris from the conduit system.

Pull the cables directly from their cores or reels into the conduits. Do not pull off and lay the cable on the ground before installation. Make the pulls in one direction only. Lubricants used shall be as recommended by the cable manufacturer or accepted by the Engineer.

Do not leave wires or cables under tension nor tight against bushings or fittings. Remove damaged ends resulting from the use of pulling grips soon after pulling the cable. Maintain the cable end seals. Do not pull open-ended cables through the conduits. Cables shall be continuous from pulling point to pulling point. The Engineer will not permit splices from pulling point to pulling point. Make splices, taps and terminations with pressure-indented connectors or lugs as appropriate or specified in the contract.

When requiring splicing, join the conductors by a ‘western union’ type splice or by using an accepted connector. Use the connectors for splicing conductors, No. 8 AWG or larger. Solder the "western union" type splice by the pouring or dipping method. Cable splices and termination shall be according to the cable manufacturer's recommendation. Submit the cable manufacturer's splicing instruction sheets for acceptance.

Trim the conductor insulation to a conical shape. Roughen the conductor insulation before applying splice insulation. Splice

insulation includes layers of thermoplastic electrical insulating tape not over 0.007 inches thick conforming to Federal Specification MIL-7798. Apply the splice insulation a thickness equal to and well lapped over the original insulation. Leave at least 2 feet of slack for each conductor at each splice.

(5) Bonding and Grounding. Secure the metallic cable sheaths, conduits and lamp posts mechanically and electrically to form a continuous system. Ground them effectively as specified in the Code and in the contract.

(6) Pullboxes. Install pullboxes at the locations shown in the contract.

Give frames and covers two coats of asphaltic base paint after installation.

(7) Conduits. Lay the PVC coated galvanized rigid steel and polyvinyl chloride (PVC) conduits carefully in trenches prepared to receive the conduits. Conduits under roadway areas and driveways shall be PVC, Schedule 80 or as shown in the contract.

Lay the conduit that will be encased in concrete to the required lines and grades. Support the conduit rigidly in place by masonry material, manufactured conduit spacers, or other accepted means. Wire the conduit so that the Contractor will not dislodge the conduit during the placing and tamping of the concrete. The thickness of the concrete around the conduits shall be shown in the contract. Use only hand shovels in compacting the concrete. Cure the concrete jackets for at least 36 hours before permitting vehicular traffic.

Install the PVC coated galvanized rigid steel conduit according to Article 344 of the Code. Use white and tinted ready-mixed paint on the threads of joints. Repair zinc-coated surfaces according to Subsection 501.03(G)(2) - Repairing of Damaged Zinc-Coated Surfaces.

Install rigid PVC conduit according to Article 354 of the Code PVC conduit connections shall be of the solvent-weld type. Make solvent-weld joints according to the conduit manufacturer's recommendations and as accepted by the Engineer. The Engineer will permit pre-assembling sections of conduit.

Make directional changes in non-metallic conduit runs such as bends and changes to clear obstructions with curved segments

using accepted deflection couplings or with short lengths of straight ducts and couplings. The deflection angle between two adjacent lengths of duct shall not exceed 6° and the bends shall not have a radius of less than 12 times the nominal size of the conduit unless using factory-made ells.

Thread the fittings for connecting non-metallic conduits to rigid metal conduits on the side that will be connected to the metal conduit. Metal conduits entering pullboxes shall end in insulating grounding bushings. Non-metallic conduits shall end in end bells.

Cap or plug and mark the ends of conduits shown or specified. Provide each conduit run with a No. 10 gage flexible zinc-coated pull wire or 1/8 inch polyolefin line extending uninterrupted through handholes for the entire length of run. Double an additional 2 feet of wire or polyolefin line back into the conduit at both ends of the run.

Ends of conduit runs shall extend at least 24 inches past the face of curb or edge of pavement, unless the ends end in pullboxes. Locate the ends accurately by special markers, markings on curbs or as specified by the Engineer.

Keep the interior of conduits clean during the construction. Plug the ends of conduits to keep the ends clear during and after construction. Install the conduits to drain toward a pullbox. The Contractor may consider a single run to drain toward both ends.

(D) Painting. Furnish the metal poles with dark bronze powder coat over clear anodized finish.

(E) Calculations. Provide electronic illumination calculations of the proposed pathway light standard to the Engineer for review and approval. Illumination calculation results shall meet or exceed the following requirements:

(1) Average Illumination: 1.0 foot-candles minimum

(2) Average to Minimum Uniformity Ratio: 3 to1 or better

(F) Field Test. Before acceptance of the work, make the following tests on lighting circuits, in the presence of the Engineer.

(1) Test for continuity of each circuit.

(2) Test for grounds in each circuit.

(3) A megger test on each circuit between the circuit and round. The insulation resistance shall not be less than the values specified in Table 627-I when measured with an instrument having a voltage rating of 500 volts.

TABLE 627-I - INSULATION RESISTANCE	
Cable or Circuit	**Minimum Resistance (ohms)**
No.14 - No.12 wire	1,000,000
25 to 50 amperes	250,000
51 to 100 amperes	100,000
101 to 200 amperes	50,000
201 to 400 amperes	25,000
401 to 800 amperes	12,000
over 800 amperes	5,000

(4) A functional test to show that each part of the system functions according to the contract.

Correct the faults in the material or the installation revealed by these tests at no cost to the State. Repeat the tests until no fault appears.

(G) Salvaging Electrical Equipment. The contract directs the Contractor to Section 202 - Removal of Structures and Obstructions, regarding existing highway facilities. When shown in the contract or specified by the Engineer, remove and salvage the existing electrical equipment including but not limited to luminaires, standards, mast arms, ballasts, transformers, service equipment, and pullboxes, otherwise the existing electrical equipment shall become the property of the Contractor and the Contractor shall remove and dispose of the existing electrical equipment at no cost to the State.

627.04 Method of Measurement. The pathway lighting system (excluding light pole base foundations), light pole base foundations, and power system for traffic signal and railroad crossing controllers will be paid on a contract lump sum basis.

627.05 Basis of Payment. The Engineer will pay for the accepted pathway lighting system (excluding light pole base foundations) on a contract lump sum basis. The price includes full compensation for submitting the equipment list and drawings; furnishing and installing the pathway lighting standards and power system to include lighting control equipment, electrical apparatus, pullboxes, conduit, and conductors; submitting warranty; and furnishing equipment, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted pathway light pole base foundations on a contract lump sum basis. The price includes full compensation for furnishing equipment, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted power system for the traffic signal and railroad crossing controllers on a contract lump sum basis. The price includes full compensation for submitting the equipment list and drawings; furnishing and installing the electrical apparatus, pullboxes, conduit, and conductors; submitting warranty; and furnishing equipment, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the following pay item when included in the proposal schedule:

Pay Item	**Pay Unit**
Pathway Lighting System (Excluding Pole Base Foundations)	Lump Sum
Pathway Light Pole Base Foundations	Lump Sum
Power System for Traffic Signal and Railroad Crossing Controllers	Lump Sum

Hauling and stockpiling of salvaged materials and equipment off the right-of-way to the locations specified by the Engineer shall be incidental to the contract work."

END OF SECTION 627

SECTION 631 – TRAFFIC CONTROL, REGULATORY, WARNING, AND MISCELLANEOUS SIGNS

Make the following amendment to said Section:

(I) Amend **Section 631.03(C) - Labeling of Signs** by revising lines 42 to 51 to read:

"**(C) Labeling of Signs**. Label back of each sign with sign stickers as directed by the State. Sign stickers will be provided by the State."

(II) Amend **Section 631.04 Measurement**, by adding the following after line 70:

"The Engineer will measure the number of regulatory, warning and miscellaneous signs as complete units of the type and design specified in the proposal.

The Engineer will not measure removal, disposal and storing of existing and temporary signs that the Contractor will not incorporate in the completed highway for payment."

(III) Amend **Section 631.05 Payment**, by adding the following after line 74:

"The Engineer will pay for the accepted quantities of regulatory, warning, and miscellaneous signs at the contract unit price per each for the type and design specified complete in place. The price shall be full compensation for excavating and backfilling, furnishing and installing materials, furnishing equipment, tools, labors and incidentals necessary to compete the work.

The Engineer will not pay for removing and disposing or storing of existing and temporary signs that the Contractor will not incorporate in the completed highway separately. The Engineer will consider them incidental to the various contract items."

(IV) Amend **Subsection 631.05 – Payment** by adding the following pay item after line 91:

"Regulatory Sign (10 Square Feet or Less)	Each
Regulatory Sign (10 Square Feet or Less) with Post(s)	Each
Regulatory Sign (More than 10 Square Feet) with Post(s)	Each
Warning Sign (10 Square Feet or Less)	Each
Warning Sign (10 Square Feet or Less) with Post(s)	Each

Street Name Sign on Mast Arm	Each
Directional Sign (10 Square Feet or Less)	Each
Directional Sign (10 Square Feet or Less) with Post(s)	Each
Relocation of Existing ____ Sign with New Post(s)	Each”

END OF SECTION 631

SECTION 632 – MARKERS

Make the following amendment to said Section:

(I) Amend **Section 632.04 Measurement**, by adding the following after line 82:

"The Engineer will measure the number of reflector marker, milepost marker and route number plate with post (bi-directional), milepost marker, and object marker per each as complete units of the type and design specified in the proposal.

The Engineer will not measure removal, disposal and storing of existing and temporary markers that the Contractor will not incorporate in the completed highway for payment."

(II) Amend **Section 632.05 Payment**, by adding the following after line 86:

"The Engineer will pay for the accepted quantities of reflector marker, milepost marker and route number plate with post (bi-directional), milepost marker, and object marker at the contract unit price per each for the type and design specified complete in place. The price shall be full compensation for excavating and backfilling, furnishing and installing materials, furnishing equipment, tools, labors and incidentals necessary to compete the work.

The Engineer will not pay for removing and disposing or storing of existing and temporary markers that the Contractor will not incorporate in the completed highway separately. The Engineer will consider them incidental to the various contract items."

(III) Amend **Subsection 632.05 – Payment** by adding the following pay item after line 101:

"Reflector Marker _____ with Flexible Post (Type A, 36" high, White)	Each
Reflector Marker _____ Mounted on New Guardrail (White)	Each
Milepost Marker and Route Number Plate with Post (Bi-Directional)	Each"

END OF SECTION 632

SECTION 638 – PORTLAND CEMENT CONCRETE CURB AND GUTTER

Make the following amendments to said Section:

(I) Amend **638.04 – Measurement** by revising lines 130 to 131 to read as follows:

"**638.04 Measurement.** The Engineer will measure curb and/or gutter, both new and reset, by the linear foot. The Engineer will measure along the front face of the curb at the finished grade elevation. If the Engineer measures gutter separately, the Engineer will measure gutter along the front face of the gutter. The Engineer will not make deduction in gutter length for drainage appurtenances installed such as catch basins and drop inlets.

The Engineer will measure Pre-Cast Concrete Parking Curb per each."

(II) Amend **638.05 – Payment** by revising lines 133 to 148 to read as follows:

"**638.05 Payment.** The Engineer will pay for the accepted quantities of curb and/or gutter at the contract unit price per linear foot for each type of curb and/or gutter specified.

The Engineer will pay for Pre-Cast Concrete Parking Curb at the contract price per each according to the contract.

Payment will be full compensation for work prescribed in this section and contract documents.

The Engineer will pay for each of the following pay items when included in proposal schedule:

Pay Item	**Pay Unit**
Curb, Type _____	Linear Foot
City & County Concrete Curb	Linear Foot
Curb and Gutter, Type _____	Linear Foot
City & County Integral Curb and Gutter	Linear Foot
Modified Gutter	Linear Foot
Pre-Cast Concrete Parking Curb	Each"

END OF SECTION 638

SECTION 645 - WORK ZONE TRAFFIC CONTROL

Make the following amendments to said Section:

(I) Amend **Subsection 645.03 – Construction** by revising lines 64 to 66 to read:

"Furnish two police officers for each location that requires work zone traffic control. If TCP is included in the contract documents, furnish number of police officers indicated in TCP, whichever is greater.

Furnish, install, maintain, and remove two (2) changeable message boards (i.e., electronic message signs) as needed for each location that requires work zone traffic control as shown in TCP, or requested by the Engineer. The cost for this work shall be incidental to contract item No. 645.0100 - Traffic Control and shall not be paid for separately."

(II) Amend **Subsection 645.03(F) - Lane Closures** by revising lines 248 to 251 to read:

"**(F) Lane Closures.** Lane closures will be allowed only during the following hours. Exceptions to lane closure hours specified require written acceptance by the Engineer. No increase in contract price or contract time will be given for lane closure restrictions specified.

(1) Weekday Road Closure (railroad crossing only).

Contractor will be allowed 24-hour closures of Fort Barrette Road in both directions between Kapolei Parkway and Roosevelt Ave. for the railroad crossing work. The total road closure time allowed shall be limited to three (3) consecutive weekdays maximum.

The Contractor shall submit roadway closure TCP and detour plans to the Engineer for acceptance. Variable message boards notifying motorists of proposed 24-hour closures shall be placed at each end of the closure limits at least 7 days prior to start of the closures.

The Contractor shall coordinate with nearby property owners, businesses, schools, government agencies and Kalaeloa Airport operators regarding the proposed road closures.

(2) Weekday Day-Time Lane Closure.

1-lane closure	**Both Directions**
Monday to Friday	7:30 A.M. – 2:00 P.M.

Contractor shall maintain one (1) lane of traffic min. in each direction during weekday day-time lane closure hours, and as directed by the Engineer.

The Contractor shall coordinate his work to minimize impacts to existing traffic patterns. Multiple lane-closures shall require approval by the Engineer. If approved, multiple lane-closures shall be implemented with adequate traffic queue storage for each lane-closure location. The Engineer may suspend multiple lane-closures if cumulative work zone traffic delays exceeded 30 minutes.

If excess traffic delays (equal to or above 30 minutes) are observed in the field by the Engineer, the Contractor shall take corrective measures and a modified TCP be submitted to the Engineer for acceptance at least 15 working days before such work could resume.

Contractor shall notify and coordinate with affected property owners prior to any lane closures and/or detours at no increase in contract price or contract time.

The Contractor shall coordinate with nearby Kapolei High School (KHS) administration staff, (808) 305-8000, when working between Roosevelt Ave. and Kapolei Parkway. This coordination shall include, but not limited to, maintaining access to school ground during special events at KHS.

The Contractor shall coordinate all work with the Hawaiian Railway Society (HRS), (808) 681-5461, when working adjacent to or within the railroad R.O.W.

The Contractor shall notify the C&C Department of Transportation Services (DTS), Public Transit Division, (808) 768-8396, and the Oahu Transit Services, Inc. Bus Operations, (808) 848-4578, or (808) 852-6016, and Paratransit Operations, (808) 454-5041, or (808) 454-5020, of any closure of street, sidewalk or bus stop at least two (2) weeks prior to starting construction operations.

The Contractor shall notify the C&C Traffic Signals and Technology Division, Department of Transportation Services (DTS), (808) 768-8388, three (3) days prior to commencing work on the existing and new traffic signal systems.

The Contractor shall notify the State Hawaii Housing Finance and Development Corp. (HHFDC), (808) 587-0620, when working in the vicinity of Kapolei Parkway and Kamaaha Ave. intersections, which are main access roads for the Villages of Kapolei maintained by HHFDC.

The Contractor shall notify the State Hawaii Community Development Authority (HCDA), (808) 594-0300, when working outside of HDOT R.O.W. in the vicinity of Enterprise Street, which is the main access road to nearby Kalaeloa Airport maintained by HCDA.

The Contractor shall notify the Hawaii FBI Headquarters, (808) 566-4300, when working in the vicinity of Roosevelt Ave. intersection for access coordination to the facility.

Maintain abutting owners' existing access until replacement access is usable. Obtain permission from abutting owners, including conditions for closing existing access. Submit copy of agreement with abutting owners before beginning work in the affected area.

See project plans for additional information on scope of work and coordination during construction.

If applicable, coordinate lane closures with adjacent project(s) at no increase in contract price or contract time.

Exceptions to lane closure hours specified require written acceptance by the Engineer. No increase in contract price or contract time will be given for lane closure restrictions specified."

END OF SECTION 645

Make the following section a part of the Standard Specifications:

"**SECTION 660 – RAILROAD SIGNAL SYSTEM**

660.01 Description. The work under this section consists of furnishing, delivering, installing, and testing all new systems required for the installation of a new highway grade crossing warning system at Fort Barrette Road. All work shall be coordinated with the Hawaiian Railway Society (HRS) (Operator) and the Hawaii Department of Transportation (HDOT) (Owner). Conform to the instructions provided by the Owner concerning work performed in the proximity of the railway, required on-track safety training of personnel, permission for fouling of the railway, flagging, personal protective equipment, and access to railway facilities. Additionally, conform to the requirements of the Federal Railway Administration and AREMA Communications and Signals Manual best practices for work that affects the operation and safety of the movement of trains.

660.02 Materials.

Vital and Non-Vital Relays	660.03(C)(2),(3)
Wire and Cable	660.03(C)(8)
Signal Cases	660.03(K)
Power Supplies, Battery Chargers and Batteries	660.03(L)
Lightning Arresters and Equalizers	660.03(M)
Signal Terminal Binding Posts	660.03(N)
Rail Connections and Bonds	660.03(O)
Sealing Compound	660.03(P)
Constant Warning Time Devices	660.03(Q)
Crossing Gates	660.03(R)
Flashing Lights and Crossarms	660.03(S)
Electro-Mechanical Bells	660.03(T)
Crossbuck Signs	660.03(U)
Junction Box Bases and Masts	660.03(V)

Event Recorders	660.03(W)
Galvanized Steel Foundations	660.03(X)
Ground Rods	660.03(AA)
Concrete Encased Conduits	660.03(BB)
Pull Boxes	660.03(CC)
Wire and Cable Tags	660.03(DD)
Locks	660.03(EE)
Tape	660.03(FF)

660.03 Construction.

(A) Fort Barrette Road Crossing. Install Signal Case as described in the Contract Documents to house the train detection and crossing warning system controls for the Fort Barrette Road Crossing. This will include a total of one flasher only crossing signal and four flasher crossing signals with gates, all equipped with LED flashers, mechanical bells, crossbucks, and junction box bases as described in the Contract Documents. The train detection system shall be as described in the Contract Documents.

(B) Further Requirements for the Work.

(1) Responsible for all transportation and storage of materials, all required tools, labor and supervision, and all required safety equipment; and maintain good housekeeping about the workplace, observing all laws, rules and regulations concerning storage of equipment onsite, protection of open trenches, work about roadways, work about railways and safety of personnel.

(2) Maintain a safe system of work and shall promptly report any accidents, either to Owner, or the Owner's designated representatives.

(3) Obtain all necessary licenses and permits.

(4) Provide and install appropriate meter service for the Railroad Crossing. Provide connection from service to the Signal Case electrical panel. As described elsewhere in this specification, the

Contractor shall be responsible for obtaining the necessary permits and inspections of the meter services and connections, and shall arrange for necessary access to same by personnel of the utility and local inspectors.

(5) Provide complete detailed as-built wiring diagrams, track plan drawings and instrument housing layout drawings. As-built drawings shall be provided to the Owner following the approval of the installed systems.

(6) Circuit nomenclature and symbols shall conform to the recommendation of the AREMA Communications and Signals Manual. All design shall be to the best current practice and shall use failsafe principles.

(7) During the field installation of the project a working set of the plans shall be maintained with changes and additions to the plans captured, and initialed, as they occur. In addition, a set of testing plans shall be maintained. All changes made to the working set shall be transferred to the testing set. All testing shall be captured, and initialed, on the testing set. At the completion of testing of the installed systems, both the working set and the testing set of plans shall be used to update the drawings to as-built condition. As-built plans will be provided to the Owner in both soft and hard formats. Soft format shall be in the form of a labeled CD-ROM with all drawing files in the Autocad 2016, Adobe PDF copies of all drawings with the reviewing engineer's seal locked on the drawings, and Adobe PDF copies of all testing documents. Hard format will include four sets of 11x17 drawings with the reviewing engineer's seal.

(8) A system of configuration management shall be used to maintain the plans during the project. Revised plans shall be issued as complete sets including all drawings, whether revisions are made to all sheets or not. Drawings that are revised will bear a new revision number and note, and changes to the plan will be highlighted as X=OUT and O=IN.

(9) All drawings shall be reviewed and sealed by an engineer qualified in the particular area of practice and licensed as a professional engineer in the state of Hawaii.

(10) Before progressing with the Work, submit drawings and catalog cut sheets for equipment to the Owner, or designated representative of the Owner, for approval. Work performed without the approval of the Owner shall, at the request of the Owner, be

completely removed, and then performed in an approved manner at no additional cost to the project. All equipment shall be designed for use on the railroad in an environment similar to that of the site and shall have a five-year history of use in similar projects.

(11) The systems shall be fully tested following installation. Testing shall be 'end-to-end', rather than incremental, and shall follow the requirements of FRA CFR49, parts 234, the requirements of HDOT and the recommendations of AREMA. All testing shall be documented using the proper test forms. No more than thirty days following the completion of installation testing, all documentation, including the as-built drawings, shall be submitted to the Owner for approval. The Work shall not be considered as completed until approval of the installation, as-built drawings, and of the final installation testing is received from the Owner.

(C) Vital and Non-Vital Relay.

(1) Requirements. Furnish and install vital and non-vital relays and plugboards as required for the Automatic Highway Grade Crossing Warning System.

(a) Vital relays shall be as described in the Contract Drawings and shall be plug in type. Vital relays and plugboards shall meet the requirements of the AREMA Communications and Signals Manual.

(b) Vital relays and plugboards shall be provided by Alstom or Siemens, or approved equivalent.

(c) The Contractor shall furnish and install non-vital relays, sockets and hold down springs as required for the Automatic Highway Grade Crossing Warning System.

(d) Non-vital relays shall be as described in the Contract Drawings and shall be as provided by Tyco in its KRPA product range, or approved equivalent.

(2) Vital relays shall be identified with the manufacturer's name, model number, contract identification and serial number. Relays and plugboards shall be provided with the identification of the circuit name of the relay.

(a) Vital relays shall comply with AREMA Communications and Signals Manual, Part 6.2.1.

(b) Vital relays shall operate on a nominal voltage of twelve (12) volts, DC, and shall be capable of continuous operation without damage when energized in the range of seven (7) to twenty-one (21) volts, DC.

(c) Vital relays shall be of the plug-in type and shall be interchangeable with relays of the same type. They shall be provided with a fastening arrangement to provide firm attachment to the relay plugboard.

(d) Vital relay plugboards shall comply with AREMA Communications and Signals Manual, Part 6.2.2. Both the vital relay and its plugboard shall be provided with registration plates that prevent the installation of the wrong type of relay on the relay plugboard.

(e) Vital relays shall be provided with a certificate of conformance from its manufacturer that provides proof that the relay was tested and found to be within the manufacturers' specifications for the particular relay.

(f) Vital relays shall not be shipped installed in the relay rack but shall be removed from plugboards, placed in its shipping box and carefully packed and secured in the signal house. They shall be reinstalled in the rack once the house has been installed on its foundations and shall be retested to assure that they meet the manufacturers' specification.

(g) Flasher relays shall comply with AREMA Communications and Signals Manual, Part 6.1.45.

1. Flasher rates shall be provided by means of a solid-state flasher module mounted on the rear of the relay plugboard.

2. The flashing rate shall be no less than 35 times per minute nor more than 65 times per minute and shall comply with AREMA Communications and Signals Manual, Part 3.2.55.

3. In the event multiple flasher relays are required at a crossing, flasher rates shall be synchronized across all flasher relays such that all signals flash in synch.

(3) Non-vital relays shall be plug-in type and shall be furnished with transparent dustproof covers that will not support combustion. Relay mounting shall permit viewing the relay without disassembly.

(a) Non-vital relays shall comply with AREMA Communications and Signals Manual, Part 6.3.5.

(b) Non-vital relays shall be mechanically secured to the relay socket, or base.

(c) Non-vital relay sockets shall have screw-type connectors for wiring to contacts and coils.

(4) Submittal Requirements. Submittals shall be made as described in the appropriate section of this specification.

(a) Vital relays and plugboards proposed for use shall be submitted to the Owner, or the Owner's designate.

(b) Non-vital relays, sockets, and hold-down springs proposed for use shall be submitted to the Owner, or the Owner's designate.

(5) Wire and Cable Requirements. The Contractor shall furnish and install the wire and cable required for the Automatic Highway Grade Crossing Warning Systems.

(6) Cables shall be suitable for installation in direct contact with earth, in trenches, cable ducts, troughs, on messengers, or in any combination of these methods.

(7) Control Cable for the automatic highway grade crossing warning system shall conform to or exceed the following requirements:

(a) Material and workmanship of the wire and cable shall be of the highest quality, assuring durability for the 40-year design life of the cable installation.

(8) Wire and cable shall conform to, or exceed, the following minimum requirements:

(a) Cable Design AWG Construction

1. Highway Flasher w/Gate 7C #6, 7C #14 Solid
2. Track Circuit 2C #6 TW Solid
3. Track Circuit Connection 1C 3/16" Stranded

4. Pedestrian Flasher 5C #6 Solid

5. Case Wiring #6, #10, or #16 Stranded, as shown on Contract Drawings

(b) Provide single and multi-conductor insulated and jacketed cable suitable for installation in direct contact with the earth, in conduit or pipe, or any combination of these types of installations, on circuits rated at up to six hundred (600) volts.

(c) The signaling cable required for this project shall consist of the following types:

(d) Sizes of wire stated above shall be considered minimum. The Contractor shall be responsible for sizing the cable to accommodate the calculated load.

(e) For one hundred twenty/two hundred forty (120/240V) volt power service circuits, either three (3) No. 2/0 AWG stranded copper conductors or three (3) No. 2 AWG stranded copper conductors or three (3) No. 4 AWG stranded copper conductors or three (3) No. 6 AWG stranded copper conductors. Cable shall be sized to provide no more than a ten (10%) percent voltage drop based on the anticipated peak load.

(f) In addition to the number of active conductors that are required in these types of cable in order to provide a complete working system, the following spare conductors shall also be provided:

1. Fifteen (15) percent spare conductors with a minimum of one (1) spare conductor in each main line cable. If multiple cables run to the same destination, the spares for all cables may be consolidated in one construction, provided that the requirement for total spares is still met.

2. Spare conductors are not required in track circuit feeds.

(B) Qualifications.

(1) The manufacture of cables in accordance with the requirements of these Specifications shall be accomplished in compliance with a Quality Assurance Program that meets the intent of ASQC Standard C1, General Requirements for a Quality Program. Such compliance shall assure the production of properly designed, well made, and thoroughly tested cable, which will render

long service life to the user. Efficient methods of production test and production evaluation shall be used, but prime concern shall be focused on the necessary formal quality requirements to ensure that cable failure cannot be attributed to actions or lack of actions by the manufacturer.

(2) To assure accountability and traceability in applicability of the quality assurance plan, the manufacturer shall prepare, and apply conductor insulating materials and cable outer coverings and shall perform conductor insulating and cable assembly and testing in its own plant.

(3) If the vendor does not normally prepare insulating materials in its own plant, it is acceptable for the vendor to have its proprietary formulations prepared at another non-owned facility. This facility shall be subject to the same Quality Assurance procedures and systems the vendor uses in its own facilities.

(4) Cable design and insulation materials offered for this service shall have a minimum of fifteen (15) years reliable experience on vital circuit signaling cables with a minimum of at least two (2) million cable feet installed.

(5) Manufacturer's product information shall indicate that wire and cable is in conformance with the applicable ASTM and ICEA-NEMA specifications and testing requirements.

(E) Conductor.

(1) Conductors shall be soft or annealed copper and conform to ASTM B33-94 or ASTM B3-95.

(2) Conductors between Signal Case and track/crossing devices shall be solid copper.

(3) The direct current resistance of the conductors shall conform to ICEA Standards Publication S-105-692-2011.

(F) Insulation (Signal Cable).

(1) The insulation shall be ethylene propylene rubber and shall meet the experience requirements, and pass the qualification requirements of these Contract Documents.

(2) The insulation shall be applied by the continuous tube method without joints; it shall be properly vulcanized, homogeneous

in character, tough, elastic, concentrically applied about the conductor, and shall fit tightly thereto. Where an insulating jacket is applied over the insulation, it also shall be homogeneous in character, tough, elastic, concentrically applied about the conductor, and shall fit tightly thereto.

(3) Insulation shall conform to AREMA Communications and Signals Manual, Part 10.3.19.

(4) The insulating compound shall be clean and free stripped, leaving the coated conductor unimpaired and ready for soldering.

(5) Insulation thickness shall be as specified in AREMA Communication and Signals Manual, Parts 10.3.15 and 10.3.16.

(G) Jacketing.

(1) Single and multi-conductor cable shall be jacketed with polyethylene in conformance with AREMA Communications and Signals Manual, Parts 10.3.16 and 10.3.21.

(H) Identification.

(1) Multi-conductor Cable. Each length of cable shall be permanently identified as to the manufacturer and year of manufacture, at intervals not more than 24 inches, with a moisture resistant marker tape under the jacket and parallel to the longitudinal axis of the cable.

(2) Single Conductor Cable. Each length of cable shall be permanently identified by printing on the surface of the cable jacket the manufacturer's name, voltage rating, and wire gauge at intervals not to exceed 24 inches.

(I) Inspections and Tests.

(1) Types of Tests. The manufacturer shall, at the point of production, carry out all of the following tests:

(a) Conductor size and physical characteristics

(b) Insulation high-voltage and insulation resistance tests

(c) Physical dimension tests

(d) Final, high-voltage, insulation resistance and conductor resistance tests on shipping reels.

(2) Certified Test Reports. Furnish certified electrical and physical test reports for the finished single conductor and multi-conductor cables.

(3) Rejected Cable. Cable, which does not meet the minimum requirements of these Specifications, will be rejected. Wire or cable, which shows defects or non-compliance with these Specifications, after arrival at the Project destination, will be rejected and returned to the manufacturer at no additional cost to the Contract.

(J) Case Wire.

(1) Signal wire shall be concentric-lay stranded conductors of annealed copper conforming to ASTM Standard B8 Class C and shall be coated with tin conforming to ASTM Standard B33.

(2) Conductors shall be insulated with ethylene-propylene rubber as described in AREMA Communications and Signals Manual, Part 10.3.19.

(3) Case wiring shall be jacketed with polyvinyl chloride (PVC) in conformance with AREMA Communications and Signals Manual, Parts 10.3.15 and 10.3.19.

(4) Case wire shall be sized as shown on the Contract Drawings. Minimum conductor size for case wiring shall be AWG 16, unless shown on Contract Drawings.

(5) Submittal Requirements. Cable and wire proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(K) Signal Cases.

(1) General.

(a) All equipment shall operate correctly and without damage over a temperature range of minus forty degrees to one hundred sixty degrees Fahrenheit (-40°F to 160°F). Where AREMA Communications and Signals Manual recommendations for specific equipment exceed the limits of this temperature range, such equipment shall conform to

recommendations set forth by the AREMA Communications and Signals Manual.

(b) The Signal Case shall be identified by a name/address sign. The name/address signs shall be installed adjacent to the main access door. The sign shall be constructed of A-2 aluminum, 0.080-inch thick minimum, secured by stainless steel vandal proof screws, white reflective enamel background with silk-screened, black enamel lettering. The Signs shall include lettering as follows:

1. First line – FORT BARRETTE ROAD

2. Second line - OR&L RWY, MP 19.70

3. Third line – DOT # 918 996 X

4. Fourth line – EMERGENCY PHONE 808-681-5461

(c) The Signal Case shall be furnished complete with an electrical panel including main breaker and required branch breakers as described in the Contract Documents.

(2) Description.

(a) Size and Equipment Mounting.

1. Signal Case shall be sized as described by the Contract Documents.

2. Clearances as described in the Contract Drawings shall be observed for the installation of equipment, racks, terminal boards and shelves.

3. Relays and electronic components which require periodic test and adjustment shall be mounted a minimum of eighteen (18) inches above floor level and not higher than six (6) feet six (6) inches (6’ - 6”) above floor level, as described by the Contract Documents.

(b) Signal Case:

1. Width and length shall be 24”x96”.

2. The Signal Case shall be located as described in the Contract Drawings, but the Signal Case shall

not be allowed to intrude into the dynamic envelope of operating trains.

(3) Construction.

(a) The Signal Case shall be fabricated of .100” 3003 aluminum with PVC peel coat to the protect exterior surfaces of walls, doors and the roof during manufacturing. The peel coat shall be removed before shipping. Signal Case walls and doors shall be insulated with 1” fiberglass faced polyisocyanurate panels.

(b) All exterior seams shall be caulked with gray RTV silicone. A manufacturer’s nameplate with the Signal Case serial number shall be riveted above the door on the front of the Signal Case.

(c) A threaded grounding stud shall be provided 6” above the floor on a wall of the Signal Case. The stud shall extend through the wall and shall provide for continuous electrical contact with the exterior shell of the Signal Case. Two securing nuts, two flat washers, a star washer and a locking washer shall be provided on the outside threads of the stud. A rubber hose shall be placed over the stud and taped in place to protect the threads during shipment. Two securing nuts, two flat washers, a star washer and a locking washer shall be provided on the inside threads of the stud. The stud shall provide a central ground point for all systems within the Signal Case.

(d) The Signal Case floor shall be constructed of .125” 3003 aluminum.

(e) Eight lockable doors shall be provided on the Signal Case, four on the front and four on the rear. Doors shall be equipped with gutters and/or rain shields.

(f) All doors shall be equipped with three-point latching devices, which ensure that the door cannot be locked until it is completely closed. Hasps and handles shall be reinforced and partly shielded to prevent breakage. The door locking mechanism shall be configured so the door can be opened from the inside even if a padlock has been inserted in the exterior locking hasp. Each door shall contain ventilating openings in accordance with manufacturer’s standards.

Louvers shall be closable, covered with fine stainless steel mesh screens and protected by weather caps, which shall prevent the entrance of moisture.

(g) All doors shall be equipped with lubricated hinge fittings and with hooks to hold the doors open at either ninety or one hundred sixty degree (90° or 160°) positions.

(h) All doors shall have gaskets to prevent dust and water incursions.

(i) Lifting hooks shall be provided on the roof of the Signal Case which shall allow completely wired and equipped case to be lifted into place. The lifting hooks shall be integral to the case and shall be designed to prevent damage during handling and lifting into place. The Signal Case shall have sufficient structural strength that no additional bracing is required to permit lifting by an overhead crane for loading, unloading and placement on the house foundations.

(j) The Signal Case shall be constructed and installed without contact between dissimilar metals, to prevent electrolysis.

(k) The Signal Case shall be equipped with a 120 volt AC thermostatically controlled exhaust fan.

(l) The Signal Case doors shall also be provided with a closable weatherproof louver covered by a stainless steel fine screen mesh and provided with filters to allow cross-ventilation of the house when the exhaust fan operates. The exhaust fan thermostat shall allow the fan to turn on automatically when the temperature inside the house reaches ninety degrees (90°F). The exhaust fan shall be protected by its own circuit breaker on the power panel.

(m) Field cables shall enter the case by means of four and three-fourths (4-3/4) inch sealed ducts in the floor on the rear of the terminal board. Four three- foot lengths of 4” schedule 40 PVC conduit with one end finished with a collar shall be provided to serve as the cable entries. All cable entrance conduits shall be sealed with a pliable duct sealant following the installation of cable.

(n) Power for the Signal Case shall be fed via buried cable from the public utility feed as described in the Contract

Drawings. Provide a feed cable. The feed cable shall be run in conduit and secured to the house structure. All wiring shall be per the best practices of the NEC and shall be sized, at a minimum, as described in the Contract Documents.

(o) A full-length terminal board shall be provided in front of the cable entry ducts as described in the Contract Drawings. The terminal board shall provide space for landing and terminating outside cables, mounting surge arresters and equalizers for circuit protection and joining the cable conductors with wires from the inside house crossing logic circuits, as well as providing space for the mounting of relays, track voltage generators and other equipment as described in the Contract Drawings.

(p) An upper portion of the terminal board shall be provided with a removable panel, for the installation of relays, as shown on the Contract Drawings.

(q) The lower portion of one side of the terminal board shall be provided with a removable panel, for the installation of batteries, as shown on the Contract Drawings.

(r) The terminal board shall be constricted of 3/4” MDO plywood in a width and height as described in the Contract Drawings. The terminal board shall be pre-drilled for the landing of cable conductors as described in the Contract Drawings. Drilled holes shall be deburred, and splintered areas around holes shall be filled with wood filler and sanded smooth. Holes shall be through-painted. The terminal board shall be painted white.

(s) Utility power shall be brought into the Signal Case via a one hundred (100) Ampere, one hundred twenty/two hundred forty (120/240V) volt, 3-wire, UL approved panel board mounted on the exterior of the Signal Case. The panel board shall be stainless steel and rated NEMA 4X. The panel board shall be as furnished by Square D, or approved equivalent.

(t) The circuit breakers shall be thermal-magnetic type, UL rated. Main and branch breakers shall be provided as described in the Contract Drawings. All circuits shall be identified by name on the inside of the panel door.

(u) Two case lights shall be provided. Light housings shall be securely attached to the house structure using appropriate brackets. All wires to the lights shall be run in flexible metal conduit. Light housings shall not be used as junction boxes. Convenience outlets shall be provided as shown in the Contract Drawings. The outlets shall be fed by a GFCI (Ground Fault Circuit Interrupter) breaker. The case lights and the convenience outlets shall be fed from separate branch circuit breakers as described in the Contract Drawings.

(v) A branch breaker shall be provided for the battery chargers and for the thermostatically controlled exhaust fan as described in the Contract Drawings. All wiring to the battery chargers and to the exhaust fan shall be run in flexible metal conduit.

(w) The Signal Case shall be factory wired and tested in accordance with the approved wiring plans.

(x) Wire, cable, wire and cable termination, cable entrances, and tagging shall be as described in the Contract Documents.

(y) All bundled wire shall be tied approximately every three (3) inches with Nylon straps in accordance with AREMA Communications and Signals Manual recommendations.

(z) No more than two (2) wires shall be terminated on any one (1) terminal post.

(aa) All wires terminated on AREMA type binding posts strips shall be fitted with an approved insulated crimp type terminal. Wire eyes shall not be permitted in stranded wires. Solid conductors may be eyed, but insulation shall not be removed by ‘ringing’ the conductor. Insulation shall be carefully removed from the conductors without marring the finish. Eyes will be large enough to slide easily over the binding post, but shall not be so loose as to extend outside the washers placed over and under the conductor. The terminals used on stranded wire shall conform to AREMA Communications and Signals Manual, Part 14.1.1.

(bb) All vital wiring shall be minimum No. 16 AWG, stranded and terminated in accordance with AREMA Communications and Signals Manual recommendations.

(cc) All wiring shall be provided with sufficient slack to prevent stress or pulling on any termination point. All relay-connected wires shall be of sufficient length to permit them to be moved to any contact on the same relay or around bends. All bends in cable/wires shall be greater than the minimum bending radius of the cable/wire recommended by the manufacturer.

(dd) Terminals shall be placed on the wire by means of a standard forming tool of the proper size, which is equipped with a lock to guarantee that the proper pressure is applied before the tool is released. Care shall be taken to assure that the correct size of wire terminal is used, and that the wire is thoroughly cleaned and centered properly in the wire terminal when using the forming tool.

(ee) Wire terminals shall not be bent, nicked or otherwise damaged. An approved wire-stripping tool shall be carefully used to remove the insulation from No. 9 AWG and smaller wires. Scraping of these conductors with any sharp instruments shall not be permitted. For wires larger than No. 9 AWG, a knife may be used to remove the insulation, with extreme care being taken to prevent nicking the conductors.

(ff) Connections to bases for plug-in relays and similar connections crimped using an approved connector. Not more than two (2) wires shall be attached to a terminal of the relay bases.

(gg) Insulated nuts shall be provided on all AREMA terminals energized with one hundred ten (110) volts or more.

(hh) Cables entering from the outside of the Signal Case shall be run and terminated such that any wire in a cable can be relocated to any place on the entrance panels.

(ii) The Signal Case shall be securely mounted on precast concrete, or galvanized steel foundations.

(jj) Provide a power-off indicator light, that is permanently on while utility power is available. Power-off indicator lights

shall be as produced by Progress Rail, or approved equivalent.

(4) Submittal Requirements. Submittals shall be made as described in the appropriate section of this specification.

(a) Supplier cut sheets for the Signal Case shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(b) Catalog data sheets and samples of the terminals proposed for use in connecting all wires to binding posts shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(c) The name/address sign shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(L) Power Supplies, Battery Chargers and Batteries.

(1) General. All DC power supplies furnished under this Contract shall meet the following minimum basic requirements:

(a) Batteries and chargers shall be provided.

(b) Cooling. The power supplies shall be natural convection cooled. No supplementary fans or other cooling devices will be allowed.

(c) Duty Cycle. The power supplies shall be rated for a continuous duty cycle.

(d) Input Voltage. The power supplies shall not be damaged by a sustained input voltage varying from zero to one hundred fifty (0-150) percent of the rated input voltage.

(e) Current Rating. The power supplies shall be sized in such a manner that no individual power supply operates at less than twenty (20) percent of its rated current output during normal operation.

(f) Output Current. The power supplies shall self-limit their output current to no more than two hundred (200) percent of their rated load unless otherwise specified herein. Reverse output current protection shall be provided to

prevent shorting or sagging of tandem supplies in the event of a filter capacitor failure.

(g) Identification. Each power supply shall be clearly and permanently labeled with the following:

1. Manufacturer's name.

2. Part or model number.

3. Serial number.

4. Input rating.

5. Continuous output rating.

(2) Batteries and Chargers. Maintenance-free storage batteries and chargers shall be supplied. Each battery bank shall consist of maintenance free storage cells. Electronic equipment battery bank shall be sized so that the operating voltages and currents are maintained for a minimum of 24 hours under normal operating conditions. Lighting and Gate Control battery banks shall be sized so that the operating voltages and currents are maintained for a minimum of 8 hours of continuous operating conditions.

(a) The charger for this battery shall be regulated and filtered. Output shall be adjustable up to nineteen (19) volts. Ripple shall not exceed one (1) volt peak-to-peak at thirty (30) Amperes output.

(b) The charger/battery shall be able to maintain/charge the batteries in both float and equalizing charge modes.

(c) The chargers shall be 12 volt/40 amp models manufactured by National Railway Supply (NRS), Railway Equipment Company, or approved equivalent.

(d) Batteries shall be maintenance-free storage batteries sized as described in this section. The electronic equipment battery bank shall have a nominal voltage of 12VDC. The lighting and gate control battery banks shall have a nominal voltage of 14VDC. Batteries shall be SAFT, GNB, or approved equivalent.

(e) Battery trays shall be provided for all battery sets. Trays shall be sized as required to accommodate the battery sets and shall be as provided by FIBERCO, or approved equivalent.

(3) Submittal Requirements. Submittals shall be made as described in the appropriate section of this specification.

(a) All battery chargers, batteries and battery trays proposed shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(b) All calculations of backup capacity shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(M) Lightning Arresters and Equalizers.

(1) Lightning arresters shall be provided to protect crossing equipment.

(2) Arrester Types.

(a) Arresters shall be specifically designed for railway signaling use.

(b) The primary function of the arresters shall be to provide line-to-ground protection. This requirement shall not exclude the arrester from performing other functions.

(c) Arresters, line-to-ground type

1. The arrester shall pass negligible current at rated circuit voltage.

2. The arrester failure mode shall be to open rather than short circuit or partially short circuit.

3. The arrester shall be suitable for use on circuits of zero (0) to thirty-five (35) volts DC without circuit impedance restrictions.

4. The arresters shall have an average DC breakdown voltage of one thousand (1,000) volts or less.

5. Arresters shall have a maximum impulse spark over voltage not exceeding two thousand (2,000) volts peak for an impulse with a ten (10) – kV/microsecond rise time.

6. The arresters shall be heavy-duty Clearview manufactured by Siemens, or acceptable equal.

(3) Submittal Requirements.

(a) Lightning arresters proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(N) Signal Terminal Binding Posts.

(1) Signal circuits shall be terminated on terminal binding posts. Terminal binding posts shall be in accordance with AREMA Communications and Signals Manual, Part 14.1.0.

(2) Submittal Requirements.

(a) Binding posts, and required accessories proposed for use, shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(O) Rail Connections and Bonds.

(1) Rail Bonds.

(a) Rail bonds shall be rail head type manufactured bonds prepared for welding. The bonds shall be as described in AREMA Communications and Signals Manual, Part 8.1.30. Rail bonds shall be as manufactured by Erico Products, Inc., or approved equal.

(b) These bonds shall be manufacturer's bonds prepared for welding by the exothermic process.

(c) Rail bonds shall be provided and installed at all bolted rail joints in the limits of the constant warning track circuit.

(2) Rail Connections.

(a) Rail connections shall be manufactured connections prepared for welding. The bonds shall be as described in AREMA Communications and Signals Manual, Part 8.1.32. Signal rail connections shall be as manufactured by Erico Products, Inc., or approved equal.

(3) Submittal Requirements.

(a) Rail bonds and connections proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall include the means of preparing the rail for welding and the welding materials to be used. Submittals shall be made as described in the appropriate section of this specification.

(P) Sealing Compound.

(1) Sealing compound shall meet the requirements of the AREMA Communications and Signals Manual, Part 15.2.15.

(2) Submittal Requirements.

(a) Sealing compounds proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(Q) Constant Warning Time Devices.

(1) Description. The constant warning time device track circuit shall be self- contained, and microprocessor controlled, with a lower frequency AF track circuit providing detection of approaching trains over the extents of the grade crossing approach and a second higher frequency AF track circuit providing detection of trains over the grade crossing. Directional stick logic shall be provided by the constant warning time device such that, following the expiration of any loss-of-shunt time, the train detection output of the device will energize allowing the grade crossing to open immediately upon being cleared by a receding train. The constant warning time device shall have normal and standby sections with a transfer logic function that allows the device to automatically switch from normal to standby in the case of a fault. The constant warning time device shall be an Alstom ElectrologIXS XP4 or approved equivalent.

(2) General performance requirements.

(a) The constant warning time device shall conform to AREMA Communications and Signals Manual, Part 3.1.15.

(b) Electronic devices and components for the constant warning time device shall conform to AREMA Communications and Signals Manual, Part 8.6.1.

(c) The system shall withstand voltage surges, when protected to the secondary level as described in AREMA Communications and Signals Manual, Part 11.2.1, and as required by the manufacturer.

(d) The system shall conform to AREMA Communications and Signals Manual, Part 11.5.1 and shall be suitable for installation in wayside equipment houses and instrument cases.

(e) The system shall be self-contained in a metal enclosure suitable for rack, shelf or wall mounting.

(f) Individual sub-systems within the constant warning time device system shall be field replaceable plug-in modules to facilitate testing maintenance. Field replaceable modules shall be keyed to prevent incorrect substitution. It shall be possible to interchange field replaceable modules without affecting the location-specific programming of the system.

(g) The constant warning time device track circuits shall operate at specified frequencies and shall be capable of operating in conditions of a minimum ballast resistance of two (2) Ohms per one thousand feet, distributed, and two (2) Ohms lumped ballast resistance at the crossing.

(h) The constant warning time device shall operate from a nominal supply voltage of 13.5 VDC with a tolerance of from 10.0 VDC to 14.0 VDC with a maximum ripple voltage of 0.2 VRMS.

(i) Vital relay drive outputs shall be isolated and capable of driving 7.5 VDC into a load of 250 ohms and 10 VDC into a load of 500 to 1000 ohms.

(j) Indicators shall be provided for diagnostic requirements, system actuation, and island occupancy.

(k) No single component failure shall result in unsafe operation of the system. Any component failure which could result in unsafe operation because of successive component

failures, shall result in interruption of its respective relay drive output.

(l) The track circuit signal applied to the rail shall be sinusoidal AC with a less than 5% harmonic content. The frequency of the track circuit shall be in the audio range between 60 Hertz and 20KHertz. The frequency of the approach track circuit shall be adjustable via user programming and shall not require frequency specific transmitter and receiver field replaceable modules.

(m) The approach track circuit shall be defined by the track connections on either side of the roadway and the termination shunts located at the extent of the approach. Termination shunts shall be appropriate for the application. Multi-Frequency Narrow bandpass terminations, configured and applied per the manufacturer, shall be provided for the termination of Constant Warning Time Track Circuits. Existing terminations shunts that are required to be moved as part of the Work, shall not be re-installed and shall be replaced with new units.

(n) The system shall be capable of predicting train time to crossing and shall provide a uniform warning time in a range centered about a pre-programmed requested warning time. No train, within the parameters described earlier, shall be allowed to arrive at the crossing with less than 20 seconds warning time.

(o) The system shall be capable of operation in either bi-directional or uni-directional configurations.

(p) The constant warning time device shall be capable of operation when configured and applied per the recommendations of the manufacturer in the vicinity of both DC track circuits and other AF track circuits.

(q) The constant warning time device shall provide a timeout period of five to twenty seconds after the train detection output has been de-energized and the approaching train shunt either stops, recedes, or is lost.

(r) Directional stick logic shall be a function of the system such that train detection outputs are energized within two seconds of a receding train clearing the island track circuit, or, in the case of a uni-directional application with no island,

within two seconds of a receding train clearing the insulated joints at the track connections. This time shall be adjustable to up to six seconds based upon the requirements of the application.

(s) The system shall be capable of operation, when configured and applied per the recommendations of the manufacturer, with 60 Hertz AC noise of up to 5 VRMS imposed upon the rail.

(t) The system shall provide for the synchronization of multiple units of common approach frequency.

(u) The system shall provide for internal redundant operation. Transfer logic and a programmable transfer time shall be part of the system.

(v) The constant warning time device may provide multiple track operation from a single operating chassis.

(3) Train Detection.

(a) Track circuits shall detect a shunt anywhere within the track circuit boundaries. Shunting sensitivity shall be 0.06 Ohm with a rail-to-rail leakage impedance of two (2) Ohms minimum per one thousand (1,000) feet of track at the operating frequency, and two (2) Ohms lumped impedance resistance at the crossing under the following conditions:

1. The constant warning time device shall, when applied per manufacturer recommendations, provide 20 second minimum warning times for constant train speeds of 2 MPH or greater.

2. The system shall be capable of detecting any track circuit discontinuity which could result in reduced warning time within 70% of the approach track. In the case of such discontinuity, the train detection output associated with that track circuit shall be de-energized.

3. Low ballast conditions that could interfere with the acquisition of approaching trains shall cause the train detection output associated with the track circuit to be de-energized.

(4) Track Leads. Provide and install connections to the rails, and all other material and apparatus including track and jumper bonds, as required for a complete track circuit installation.

(5) Termination Shunts. Provide and install all necessary termination shunts for the constant warning time device as described in the Contract Drawings. Narrow bandpass termination shunts shall be Alstom FSS - 1F/2F multiple frequency termination shunts, or an approved equivalent. Narrow bandpass termination shunts shall be installed in a PVC tube sealed on one end with a glued cap and on the other end with a gasketed cap and shall be buried outside the rails in such a manner as to create a neat installation and to reduce tripping hazards. Attachment wires shall be connected to the rails as described elsewhere in this specification and shall be neatly dressed along the rails and ties. Where required, dummy track loads shall be sized as required for the application and shall be of a type that are suitable for installation in the termination shunt tube.

(6) Design Requirements

(a) The equipment shall meet FRA requirements. The equipment shall meet or exceed the standards and recommendations of the AREMA Communications and Signals Manual. The equipment shall be applied per the recommendations of the manufacturer. Track circuits shall be configured as described in the Contract Drawings.

(b) All terminations, cable materials, and methods shall be of commercially available types. Any terminals for the direct connection of underground cables shall be AREMA approved binding posts.

(c) Parts shall be available for a minimum of ten (10) years after Final Acceptance.

(d) Environment. Equipment shall meet the basic temperature requirements, without heating or cooling enhancements such as heating strips and fans.

(e) Inputs for the equipment shall be electrically and physically isolated from one another.

(f) Outputs for the equipment shall be electrically and physically isolated from one another.

(g) Lightning Protection. Lightning protection devices shall be provided according to the manufacturer's standard. Protection against lightning, surges, spikes, and over-voltage shall be provided. Protect all input and output lines and any auxiliary equipment as necessary.

(7) Submittal Requirements.

(a) All Constant Warning Time Devices, including all Modules required for their operation, shall be submitted to the Owner, or the Owner's designated representative, for approval. Submittals shall be made as described in the appropriate section of this specification.

(R) Crossing Gates. Crossing gates shall be provided as shown on the Contract Drawings. The gate mechanisms shall be furnished in accordance with AREMA Communications and Signals Manual, Part 3.2.15 and the following:

(1) Gates shall include mechanisms, arms, adjustable counter-weights, lights, wiring and all of the accessories necessary for a complete system.

(2) Gate mechanisms shall be of the power-up type. The gate shall be locked in the up position by electromagnetic means. If the battery power fails, the gate arm shall lower at a controlled rate to the horizontal position by gravity. For normal operation, gates shall be powered down for the initial portion of travel. Means shall be provided for snubbing the final portion of the travel in each direction. Gate mechanisms shall be Siemens S-60 or approved equal.

(3) Gate arms shall be of sectional construction with the base section aluminum and the other sections fiberglass. Gate arms 33 feet and longer shall be comprised of three sections and may only be used with authorization. Gate arm lights shall be firmly attached to minimize vandalism. Arms shall be vertically striped with high-intensity, red and white retro-reflective material. Gate arms shall be Railway Equipment Company EZ-Gate or approved equal.

(4) All gates shall be restrained against wind by using one post-mounted tubular-style wind guard per gate.

(5) Gate arms at medians shall extend to within 1 foot of the curb face of the median. At crossings with two gates protecting one direction of travel, the gate arms which face each other shall be approximately equal length and shall extend so the gap between them is not less than 6 inches and not more than 2 feet

(6) Gate arm LED light units shall be furnished in accordance with AREMA Communications and Signals Manual, Part 3.2.40. The assemblies shall be easily replaceable and plug connected with a wiring harness. The lens diameter shall be 4 inches. When the gate arm light units are operating, the light closest to the gate arm tip shall be constantly illuminated and the other lights shall be illuminated alternately at the rate of 35 to 55 flashes per minute, and shall operate in unison with the lights on the flashing light signal. Gate arms and light kits must be fully interchangeable and compatible with the existing gate arm types on the system where possible.

(7) All gate mechanisms shall be equipped with a set of circuit controller contacts which shall close when the gate arm, associated with the gate mechanism, is between 0 degrees and 5 degrees from horizontal. This contact shall be used to indicate that the gate is in the horizontal position and shall be recorded.

(8) Gate arm counter weights, for all lengths of gate arms, shall be installed on both sides of the gate mechanism. An equal amount of counterweight shall be installed on each side.

(9) In all cases the gate mechanism shall control the movement of the counterweight arms:

a. With power

b. Without power

c. With gate arm

d. Without gate arm

(10) Gate mechanism shall provide maintenance switch to manipulate counterweight arms in the absence of a gate arm and shall provide a means of locking counterweight arms in the horizontal position for gate arm replacement.

(11) Gate mechanisms shall be located in compliance with MUTCD.

(12) Submittal Requirements.

(a) All gate mechanisms, gate arms, counterweights, lights, wiring, and all accessories shall be submitted to the Owner, or the Owner's designated representative, for approval. Submittals shall be made as described in the appropriate section of this specification.

(S) Flashing Lights and Crossarms.

(1) Flashing Lights mounted on cantilever masts, cantilever arms and gate masts shall comply with AREMA Communications and Signals Manual, Part 3.2.35. Flashing lights shall be as manufactured by Siemens or Progress Rail.

(a) Flashing Lights shall be 12” LED units.

(b) Flashing Light bodies, horns and crossarms shall be constructed of cast aluminum.

(c) Flashing Light units shall be equipped with 24” backgrounds and with 8” hoods constructed from aluminum and painted flat black.

(d) Flashing Light units shall produce a uniform light output in a highway crossing red color.

(e) Flashing Light units shall be capable of operation at both 10VDC and 10VAC.

(f) Flashing Light unit body shall be marked with the manufacturer’s name, model number and date of manufacture.

(g) Crossarms for flashing lights shall have models capable of 5” mounting. Crossarms shall conform to AREMA Communications and Signals Manual, Parts 3.2.50 and 3.2.51.

(h) All bolts, nuts and washers for the crossarms shall be stainless steel. All threaded parts exposed to weather shall be coated with anti-seize compound.

(2) Submittal Requirements.

(a) Flashing light units, crossarms and hardware proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(T) Electro-Mechanical Bells.

(1) Requirements. Electro-mechanical Bells shall conform to the requirements of AREMA Communications and Signals Manual, Part 3.2.60. Bells shall be provided as described in the Contract Drawings and as described below.

(a) Bell shall be designed to be mounted on top of either a 4” or 5” pipe post.

(b) Bell shall be an electro-mechanical bell as described in AREMA Communications and Signals Manual, Part 3.2.60.

(c) The outside dimensions of the bell, complete with the pipe post attachment shall not exceed the following:

1. Height 18 inches

2. Width 15 inches

3. Depth 10 inches

(d) The bell shall conform to AREMA Communications and Signals Manual, Part 11.5.1, Recommended Environmental Requirements of Electrical and Electronic Railroad Signal System Equipment, Class B.

(e) The bell housing shall be of aluminum or cast iron and shall have an opening of not less than 1” in diameter to allow wire entrance in the pipe post base. Binding posts conforming to AREMA Communications and Signals Manual, Part 1.4.1.C, shall be provided. Binding posts shall be clearly marked with indications of polarity and shall be readily accessible.

(f) The bell shall have a nominal operating voltage of 12VDC and shall provide satisfactory operation when the operating voltage is from 75% to 125% of the normal operating voltage.

(g) The bell shall provide between 100 and 325 rings per minute. Rings shall be so timed that no one sound wave interferes with subsequent waves.

(h) The bell shall not be louder than 105dba nor softer than 85dba when tested as described in AREMA Communications and Signals Manual, Part 3.2.60. It shall not produce radio interference and shall conform to AREMA Communications and Signals Manual, Part 11.5.1. Program memory for the bell shall be nonvolatile and shall not depend on any power source for memory integrity.

(i) The bell shall be identified with a tag attached inside the housing and marked with the following data:

1. Manufacturer's name.

2. Tone Type.

3. Manufacturer's part number/model number

4. Serial Number.

5. Operating Voltage.

6. Date of manufacture.

7. Rated dB(A) output.

(2) Submittal Requirements.

(a) Electro-mechanical bells proposed for use shall be submitted to the Owner, or to the designated representative of the owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(U) Crossbuck Signs.

(1) Crossbuck signs shall be provided for each new signal.

(a) Crossbuck signs shall conform to AREMA Communications and Signals Manual, Part 3.2.70.

(b) Crossbuck signs shall be constructed of aluminum with high intensity reflective sheeting. Lettering shall be round type 5 ½". A strip of retroreflective white material not less than 2" wide shall be used on the back of each blade as described in MUTCD, Section 8B.02.

(c) Hardware for the mounting of the crossbuck signs shall conform to AREMA Communications and Signals Manual, Part 3.2.96A.

(d) Crossbuck signs shall be mounted on extension brackets. Extension brackets shall conform to AREMA Communications and Signals Manual, Part 3.2.85.

(2) Submittal Requirements.

(a) Crossbuck signs, extension brackets, and mounting hardware proposed for use shall be submitted to the Owner, or to the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(V) Junction Box Bases and Masts.

(1) Junction box bases and masts shall be provided for each new signal.

(a) Junction box bases shall conform to AREMA Communications and Signals Manual, Parts 7.2.41A or 7.2.41B.

(b) Junction box bases shall be of the split base variety and shall have an adequate number of terminals to land all control, indication, power and lighting conductors for the signal. Where necessary, double junction box bases may be used.

(c) Junction box bases shall be of cast aluminum and shall accommodate a 5" O.D. pipe post mast.

(d) Masts shall be constructed of 6061 aluminum and be schedule 80. Masts shall be 5" O.D. and shall be a minimum of 17' in height. Handholes shall be factory drilled. Field cutting of handholes with a torch shall not be permitted.

(e) Masts shall be provided with appropriate pinnacles.

(2) Submittal Requirements.

(a) Junction box bases and masts proposed for use shall be submitted to the Owner, or to the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(W) Event Recorders.

(1) Event Recorder. Furnish and install an event recorder to monitor train operations at the highway grade crossing. The recorder shall be mounted in the Signal Case.

(a) The event recorder shall be of the microprocessor type. The event recorder shall have a service proven history of a minimum of 3 years on an operating rail passenger system with similar application.

(b) The event recorder shall conform to the requirements of AREMA Communications and Signals Manual, Part 3.1.29 and 3.1.29A.

(c) The event recorder installed shall have sufficient memory to store a minimum of 16,000 events before the first occurrence recorded is written over. When an event occurs, the recorder shall also store the time and the state of all other items that are being monitored.

(d) Design and wire circuits to monitor grade crossing events, as indicated on the Contract Drawings.

(e) Local access to stored data on the event recorder shall be by using a PC via Ethernet port.

(f) Event recorder shall be programmable for reporting events. The recorder shall store and print sequential events at one line per event. The printout shall display the date, time, function nomenclature, and event description. Coded printouts, which include ones and zeroes, numerical or alphabetical codes, non-English abbreviations, or other not readily understood nomenclatures are not acceptable.

(g) The event recording device shall indicate, as a minimum, a change of the following events and shall record both date and time.

1. XR or crossing control relay
2. Island position
3. Preemption Outputs
4. Gates up
5. Gates down
6. Power on
7. Battery below threshold

(2) Submittal Requirements.

(a) Event recorder proposed for use shall be submitted to the Owner, or to the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(X) Galvanized Steel Foundations.

(1) Galvanized Steel Foundations shall conform to the requirements of AREMA Communications and Signals Manual,

Parts 14.4.17 through 14.4.23, as appropriate. Galvanized steel shall be 72” in height.

(a) Steel used in the foundations shall conform to the requirements of ASTM Standard A36/A36M-08. Steel shall be hot dipped galvanized and shall conform to the requirements of ASTM standard A123/A123M-12 and shall have a minimum galvanization thickness of 0.0034 inches.

(b) Bolts, nuts and washers shall be galvanized or zinc plated and shall conform to AREMA Communications and Signals Manual, Part 15.3.1.

(c) All joints shall be welded by American Welding Society certified welders using certified welding procedures.

(2) Submittal Requirements.

(a) Galvanized Steel Foundations proposed for use shall be submitted to the Owner, or the Owner’s designated representative, for approval. Submittals shall be made as described in the appropriate section of this specification.

(b) Calculations, signed and sealed by an engineer licensed in the state of Hawaii, shall be provided for the proposed galvanized foundations.

(Y) Precast Concrete Foundations.

(1) Precast Concrete Foundations may be used as an alternative to Galvanized Steel Foundations.

(a) Precast Concrete Foundations shall conform to AREMA Communications and Signals Manual, Parts 14.4.1A, 14.4.3A, 14.3.3B, 14.4.3C, and 14.4.11.

(2) Submittal Requirements.

(a) Precast Concrete Foundations proposed for use shall be submitted to the Owner, or the Owner’s designated representative, for approval. Submittals shall be made as described in the appropriate section of this specification.

(Z) Cast-In-Place Concrete Foundations.

(1) Cast-in-place Concrete Foundations may be used as an alternative to Galvanized Steel Foundations.

(a) Cast-in-place Concrete Foundations shall conform to AREMA Communications and Signals Manual.

(2) Submittal Requirements.

(a) Cast-in-place Concrete Foundations proposed for use shall be submitted to the Owner, or the Owner's designated representative, for approval. Submittals shall be made as described in the appropriate section of this specification.

(b) Calculations, signed and sealed by an engineer licensed in the state of Hawaii, shall be provided for the proposed Cast-in-place Concrete Foundations.

(AA) Ground Rods.

(1) Ground Rods.

(a) Furnish and install three-fourths (3/4) inch by ten (10) feet copper covered ground rods driven to a minimum depth of 10'2" for all new and relocated signals. A #6 AWG bare solid, soft-drawn copper conductor shall be run from the rod to the signal, or cantilever, mast. The conductor shall be exothermically welded to the ground rod and to the signal mast using a product such as produced by Erico Products, Inc., or an approved equivalent.

(b) Furnish and install a minimum of four (4) three-fourths (3/4) inch by ten (10) feet copper covered ground rods driven to a minimum depth of 10'2" for the Signal Case. Ground rods shall be connected together with a 4/0 bare copper wire to form a grid. The conductor shall be exothermically welded to the ground rods with a product such as produced by Erico Products, Inc., or an approved equivalent.

(c) The Signal Case ground buss plate shall be connected to the ground grid with a minimum of two #6 AWG bare solid drawn copper conductors.

(d) Test and measure ground resistance of each ground connection in an approved manner and add as many ground rods as necessary to achieve a resistance between the object being grounded and the earth ground not to exceed 25 Ohms. This testing shall be in accordance with one of the following:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE) Standard 81 (Guide For Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1):

Normal Measurements), or IEEE Standard 81-2 (Guide For Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems (Part 2), as applicable.

2. AREMA Communications and Signals Manual, Part 11.4.1.

(2) Submittal Requirements.

(a) Ground rods, exothermic welds, and ground wire proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of the specification.

(BB) Concrete Encased Conduits.

(1) Concrete Encased Conduits. Concrete encased conduits for the routing of signaling cables shall be furnished and installed. Concrete encased conduits shall be installed where it is necessary to route cables beneath the roadway, pavement, or the track. Concrete encased conduits shall be according to details provided in contract plans for traffic signal concrete encased conduits. Concrete pull boxes shall be provided at the Signal Case, either side of the roadway, and at points in conduit runs where pulling pressures would exceed recommendations.

(a) Galvanized Rigid Steel (GRS) Conduit: Conduit and fittings shall be made of the best grade standard weight steel pipe protected inside and outside by a coat of hot-dip galvanizing. Minimum size of conduits shall be 2-1/2” (4” max); however, it is the Contractor’s responsibility to assure that the size of the conduit is suitable to assure no more than 40% fill and to reduce necessary pulling pressures and the possibility of cable jams.

(b) Polyvinyl Chloride (PVC) Conduit: Thick wall polyvinyl chloride conduit, high impact schedule 80, herein referred to as PVC conduit. Where elbows are used, they shall be the long radius type.

(c) A pull line shall be provided in each conduit. The pull line shall be a minimum of 3/16” in diameter with a tensile strength of 720 pounds. The pull line shall be a polypro material, highly visible bright yellow and weather resistant.

(d) Conduit openings shall be sealed using an appropriate sealing compound. The sealing compound shall be suitable for burial and shall be impervious to contaminants in the soil and wet conditions. Stuffing the ends of conduits with rags or paper shall not be permitted.

(e) A marker tape fabricated from color-coded polyethylene shall be buried approximately 12” above the conduit continuously along the cable run. The marker tape shall be bright yellow, 6” wide and continuously coded in black lettering with the following legend: CAUTION! BURIED CABLE!

(f) A mandrel shall be run through the conduit before the installation of cable. The mandrel shall be appropriately sized for the conduit and shall be tapered on both ends to allow it to be pulled in either direction. The mandrel shall be fabricated from a soft material that will not cut the conduit walls.

(2) Submittal Requirements.

(a) Conduit, conduit fittings, cleaner solution and solvent cement, pull line, and marker tape proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of the specification.

(CC) Pull Boxes.

(1) Requirements. Pull boxes shall be precast concrete with 28-day, 4,500 PSI or greater compressive strength concrete and designed for AASHTO H-20 street loading. Use extension sections to increase vertical dimensions, as required.

(a) Conduit entrances shall be provided on all four sides. Knockout panels or precast individual conduit openings may be used. On sides where no conduits are installed under this contract, provide 1’ 3½” by 1’ 3½” knockout panels for future conduit installation.

(b) Pull boxes shall utilize heavy-duty frames and covers suitable for H-20 street loading. Diamond plate covers of a solid design, with two handles for removal, shall be provided.

(c) Each pull box shall have one pulling iron embedded in the concrete wall near the floor in each corner. 3/4” round

stock securely fastened to the overall steel reinforcement shall be used.

(d) All hardware provided for use after the pull box fabrication shall be steel, hot-dip galvanized.

(2) Installation. Pull boxes shall be installed at the cable entrance end of the Signal Case, either side of the roadway, and where calculations indicate they are necessary to reduce cable pulling pressures to recommended levels.

(a) Over excavate at least 12 inches around the sidewalls of the pull boxes for ease of installation and to prevent sluffage.

(b) Conduits terminating at the pull box shall be terminated with bell ends, plumb, and free of defects or rough edges.

(c) Bedding, consisting of one foot, minimum, of ballast, shall be installed and finished graded and level.

(d) Backfilling shall be as per the specification section on excavating. Backfilling with ballast shall not be done until pull box is completely assembled. Backfill shall be compacted progressively in layers.

(e) Covers and conduits shall be routed with a non-shrink cement grout consisting of two parts sand, one part cement and ample water to form a heavy plastic slurry. It should be applied in a manner to ensure filling of all voids in the joint being sealed.

(3) Submittal Requirements.

(a) Pullboxes proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(DD) Wire and Cable Tags.

(1) Requirements. Tags shall be provided on cables, wires, terminal boards, relays and wayside devices as described in this section. The lettering on the tags shall be easily readable. The minimum acceptable font size shall be 10 points. A point is defined as 1/72 of an inch. The nomenclature used on the tags shall correspond to that shown in the Contract Drawings.

(2) Cables. Each conductor in each cable shall be tagged on both ends with its nomenclature. Spare conductors shall be tagged with their nomenclature.

(3) Wires. All wires shall be tagged at each termination point with a waterproof sleeve-type tag. Each terminal board terminal shall also be tagged with a waterproof flat-type tag securely fastened to the front of the board. The lettering on all tags shall be typed or computer generated and waterproofed; tag lettering shall also be permatized. Hand lettering of tags will not be allowed. The wire tags shall bear the following information in the sequence listed:

(a) Wire nomenclature.

(b) Near end termination point (rack number, row and contact number, if applicable).

(c) Far end termination point (rack number, row, and contact number, if applicable).

(4) Terminal Boards. All external wires, cables, and wires from terminal boards to terminal boards shall be tagged at both ends. The individual wires shall be tagged with a white, waterproof, plastic, flat tag suitable for slipping over the wire insulation prior to termination.

(a) Tags shall bear the following information in the sequence listed:

1. The nomenclature of the wire.

2. Local terminal designation.

3. Terminal designation for the far end of the wire.

(b) This nomenclature shall be in waterproof black printing. Hand lettering of tags will not be allowed. Tags for main terminal boards shall attach to the board with escutcheon pins.

(5) Relays. Tags for wires terminating at relays and relay bases shall be of the sleeve type and shall be white with black printing. Hand lettering of tags will not be allowed. Tags shall show the following information in the sequence listed:

(a) Nomenclature of the wire.

(b) Relay contact number.

(c) The terminal or contact designation for the far end of the wire.

(6) Wayside Devices. Tags at wayside devices shall be of the sleeve type and shall bear the wire nomenclature, terminal number, and cable number.

(7) Submittal Requirements.

(a) Wire and cable tags proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(EE) Locks.

(3) Provide screw locks for all equipment enclosures that have hinged or removable doors, and for other specific devices defined herein that must be secured. These locks shall be equipped with a bronze chain, which shall be attached to the housing adjacent to the lock location. Provide all necessary screws, washers, nuts and other fastenings necessary for this attachment.

(4) Locks shall be provided for, at a minimum, all Signal Case doors, the key control box door, all junction box doors and all gate mechanisms, as well as all other devices provided with a hasp. Devices that have built-in screw locks, such as flashing light bodies, shall not require additional security.

(5) Submittal Requirements.

1. Locks proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(FF) Tape.

(1) Electrical Tape. The Contractor shall furnish and apply field-applied electrical tape. Electrical tape shall be made of Electrical tape shall be “Scotch Super 33+”, or approved equivalent.

(2) Friction Tape. The Contractor shall furnish and apply field-applied friction tape. Friction tape shall be ¾” in wide and shall be overlapped ¼ of its width in application. Applications shall be give an coating of insulating paint such as “P and B” supplied by the Rubberoid Company, or acceptable equivalent.

(3) Submittal Requirements.

(a) Tape proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of the specification.

(GG) Engineering Requirements.

(1) Engineering Drawings. The Contract Drawings represent a solution to the requirement for a complete working signal system and are developed around specific products and procedures. Revisions to the Contract Drawings to show design changes and substitutions of products shall be the responsibility of the Contractor. Additionally, while the Contract Drawings are intended to be as correct as possible, it is the responsibility of the Contractor to assure that the signal systems provided work correctly and safely. Revisions required to the Contract Drawings to achieve this are the responsibility of the Contractor. These drawings shall be submitted and approved prior to the factory wiring of the Signal Case.

(2) Revised Contract Drawings, or new drawings provided as part of the project will be drawn using AutoCAD 2016. All new drawings will utilize the titleblock used for the Contract Drawings.

(3) Provide a Project Engineer to be responsible for the installation and testing of all systems. The Project Engineer shall have the authority to make decisions relating to progressing the project, and shall be the Owner's point of contact for the project. The Project Engineer shall have a minimum of 10 years' experience in the installation and testing of signal systems of a similar size and scope. Submit the resume of the proposed Project Engineer to the Owner for approval. No work shall be performed until the Project Engineer has been approved. In addition, the Project Engineer may function as the day-to-day lead for the work being performed. If an individual other than the Project Engineer is to be responsible for oversight of the day-to-day work, their resume shall also be submitted to the Owner. A level of experience similar to the Project Engineer is required for this position. The Owner reserves the right to disqualify the Project Engineer or day-to-day lead at any time during the course of the work. This right is at the sole discretion of the Owner and Is not subject to protest or appeal.

(4) Provide signalmen who will perform responsible signal work during the project. Responsible work shall be defined as work that affects the safety of the signal system and highway crossing

systems and includes testing of disarranged circuits, installation of software, validation of circuits and software, and oversight of laborers. Laborers are defined as individuals performing such work as digging trenches, pulling cable, landing cable, setting signals and other such work. The Contractor shall provide adequate personnel on the project to perform the responsible work. If, in the opinion of the Owner, the Contractor does not provide evidence that he has adequately staffed the project, the Owner reserves the right to stop the work until such time as it is adequately staffed. The Owner reserves the right to disqualify any signalman at any time during the course of the work. This right is at the sole discretion of the Owner and Is not subject to protest or appeal.

(5) Submittal Requirements. Submit the following listed items to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of the specification.

(a) Resumes. Submit the resumes of the Project Engineer, day-to-day lead, and signalmen. The resume of the proposed Project Engineer shall be submitted immediately following Notice to Proceed.

(b) Engineering Drawings. Engineering Drawings shall be submitted to capture proposed changes from the Contract Drawings that result from the Contractor's design verifications and material submittals.

(c) As-Wired Drawings. As-Wired Drawings shall be submitted to capture changes to the Contract Drawings that result from the wiring and factory testing processes.

(d) As-Built Drawings. As-Built Drawings shall be submitted to capture the changes to the Contract Drawings that result from the installation and field testing processes.

(e) Configuration Management. The Contractor shall submit the serial numbers of all electronic modules and systems installed new or provided as replacement or improvement of existing systems.

(HH) Installation Requirements.

(1) Signal Case.

(a) Install Signal Case level on galvanized, or precast concrete, pier supports with the bottom of the case at least six (6) inches above the finished grade.

(b) The nearest edge of the Signal Case shall be no closer than 25’ from the centerline of the track.

(c) A 3” layer of AREMA #5 walking stone shall be placed to provide enough level walking space (minimum two (2) feet) all around the Signal Case for maintenance access.

(d) All cables or wiring shall be neatly routed, and shall be securely fastened at 3” intervals with tie wraps.

(e) The electrical meter shall be removed from the meter service socket when connection feed cable between the service and the Signal Case panel board. The main breaker of the panel board shall be opened to remove the case load from the panel lugs while the meter is installed in its socket. Only after the feed cable and meter have been installed shall the main breaker be closed to power the Signal Case from the public electrical utility.

(f) Test all electrical circuits and outlets in the Signal Case. Assure that all house loads are connected to the panel through branch breakers and that the breakers exercise positive control over the loads. Test the function of the exhaust fan by setting the thermostat below the ambient temperature. After confirming the operation of the fan, set the thermostat at 90º F.

(2) Crossing Signals.

(a) No part, either fixed or movable, of any signal layout shall project into the clearance envelope for the railway.

(b) Minimum clearance of crossing signals, including all parts, either fixed or movable, shall be maintained per the recommendations of the MUTCD.

(c) All crossing signals shall be equipped with a twenty-four inch (24”) aluminum background and hood painted flat black.

(d) Signals shall be aligned and focused, both horizontally and vertically, in conformance with the recommendations of AREMA Communications and Signals, Part 3.3.5.

(e) The top of all crossing signal and cantilever foundations shall be a maximum of 4” above the final grade. The top of the foundations shall be no higher than the crown of road, or sidewalk, that the signal governs.

(f) Foundations shall be installed level and plumb. Signals shall be installed level and plumb on foundations. Normal shimming is allowed; however, excessive shimming shall not be permitted and shall be grounds for the rejection of a signal or a foundation. The judgment of the Owner is final in this matter, and the Contractor shall replace rejected signals or foundations at no additional cost to the project.

(g) A 3” layer of AREMA #5 walking stone shall be placed around all signals following the completion of excavations to provide a level walking space, a minimum of 2’ wide, around the signal for maintenance.

(3) Track Connections.

(a) Rail connections for track circuits shall be made by means of a three- sixteenths (3/16) inch insulated bondstrand, length as required, manufacturered by Erico Products, or approved equivalent, with one end pressed into a copper sleeve for welding to the rail by the exothermic welding process at the neutral axis on the outside (fieldside) of the rail. Before applying the weld, rail shall be ground to a bright and clean condition by means of a grinding wheel. A file or handstone shall not be used for this purpose. Welds should be clean and should not have drips or voids. Any weld which shows any defect shall be replace at no cost by the Contractor. The Owner shall have final judgment of the condition of welds. The other end of the bond shall be finished in a 3/16-to-3/16 sleeve. A length of 3/16 inch bondstrand shall be attached to the bond and run to a trackside bootleg where a 3/16-to-6 sleeve shall be used to attach the bondstrand to the twisted #6 U.G. trackwire. An appropriate crimping tool shall be used for crimping the sleeves. The sleeve shall be covered with 3 layers of fabric tape, and a coating of insulating paint.

(b) The bootleg shall be a 3’ length of brake hose. The connection between the bondstrand and the trackwire shall be made within the bootleg. Before placing the connection into the bootleg, it shall be taped and painted. The bootleg

shall be stapled to the end of the tie. Bondstrand shall be stapled to the tie at least 4” below its top surface. Rail clips shall be used to secure the bondstrand along the rail. Track connections shall be neatly dressed to reduce the likelihood of damage from dragging equipment or vandals.

(c) Termination shunts shall be buried at trackside just beyond the ends of the ties. Where possible, the termination shunt shall be buried such that personnel are not between tracks when working. The bondstrand from the termination shunt shall be stapled to the tie between the rails. Rail clips shall be used to secure the bondstrand along the rail. Connections shall be made to the rail by means of a three-sixteenths (3/16) inch insulated bondstrand, length as required, manufactured by Erico Products, or approved equivalent, with one end pressed into a copper sleeve for welding to the rail by the exothermic welding process at the neutral axis on the outside (fieldside) of the rail. Before applying the weld, rail shall be ground to a bright and clean condition by means of a grinding wheel. A file or handstone shall not be used for this purpose. Welds should be clean and should not have drips or voids. Any weld which shows any defect shall be replaced at no cost by the Contractor. The Owner shall have final judgment of the condition of welds.

(4) Excavating.

(a) Prior to beginning any excavation the Contractor shall locate all existing underground facilities. It shall be the Contractor’s responsibility to locate and mark all underground facilities. The Contractor shall be responsible for any damages to underground facilities.

(b) Turf and sod shall be removed and stored for later reinstallation.

(c) Wire, cable and concrete encased conduit shall be buried to a depth of 36” below the surface of the finished grade.

(d) Ballast shall be protected from contamination during excavating.

(e) Horizontal boring shall be used for the installation of concrete encased conduit beneath existing roadways and sidewalks, and beneath the tracks.

(f) Excavations, and cuts in roadways and sidewalks shall be made in a workmanlike manner and so as to cause the least amount of damage. Cuts in roadways and sidewalks shall be saw cut. Should damage to a sidewalk, gutter, curb or section of roadway be caused by excavations, the Contractor shall replace it in kind. Damage caused by longitudinal cuts requires only the replacement of the damaged area. Damage caused by transverse cuts requires that the entire damaged concrete section is replaced.

(g) Excavations in asphalt shall be replaced with appropriate hot mix asphalt.

(h) Open trenches and foundation holes shall be protected. Excavations under track, or in the vicinity of the track shall be closed the day that they are opened. Excavations for foundations or trenches shall be made immediately prior to the installation of the foundation or conduit.

(i) Excavated material shall be removed and disposed by the Contractor at no additional cost to the project. Material shall be disposed of in an approved manner. The Contractor is responsible for all required permits and licenses for the disposal of such material.

(j) Trenches may be excavated manually or with mechanical trenching equipment. Trench walls shall be vertical to minimize the disturbed area. The bottom of trenches shall be smooth and free of coarse aggregate. Blades of road patrols or graders shall not be used to excavate the trench.

(k) Trenches shall be at least 6” wide. Where multiple conduits are installed in a trench, the width shall be increased accordingly.

(l) If rock excavation is encountered, the rock shall be removed to a depth of at least 3” below the required excavation depth. It shall be replace with bedding material of earth or sand containing no mineral aggregate particles that would be retained using a ¼” sieve. The Contractor shall

ascertain the local conditions for excavation before bidding. Unexpected conditions shall not be cause for changes to the project price.

(m) Backfill and trench restoration shall be according to details provided in contract plans for traffic signal concrete encased conduits.

(n) A marker tape fabricated from color-coded polyethylene shall be buried approximately 12” above the conduit continuously along the cable run. The marker tape shall be bright yellow, 6” wide and continuously coded in black lettering with the following legend: CAUTION! BURIED CABLE!

(5) Installation of Cable.

(a) Power cable mounted on poles shall run down the pole and underground for entrance to the Equipment House. The cable shall be properly secured as it runs down the pole and a suitable guard shall be installed from just below ground level to a height of 6’.

(b) Wire must not be nicked or twisted when forming eyes or applying terminals. Formed wire eyes shall be placed on terminals to ensure closing of the eye when terminal nuts are tightened.

(c) Wiring of all appliances shall conform to the applicable parts of the AREMA Communications and Signals Manual.

(d) Precautions shall be taken to prevent the kinks or twisting of wire and cable during installation. Kinks or twists that unavoidably occur shall be removed by hand. Insulation shall not be injured or marred by dropping, stepping, or throwing materials or tools on wire or cable. Wire and cable shall not be pulled over rough surfaces.

(6) Rail Bonds.

(a) Non-insulated joints shall be bonded with a rail-head bond. Before applying the weld, rail shall be ground to a bright and clean condition by means of a grinding wheel. A file or handstone shall not be used for this purpose. Welds should be clean and should not have drips or voids. Any weld which shows any defect shall be replaced at no cost by

the Contractor. The Owner shall have final judgment of the condition of welds.

(KK) System Safety.

(1) System Safety. The Contractor shall perform comprehensive safety analyses to identify all potentially hazardous conditions. The Contractor shall perform, document and submit quantitative analyses as required to ensure that adequate safety consideration has been given. Apply system safety analyses to:

(a) Evaluate alternatives.

(b) Evaluate and verify safety requirements of the signaling system.

(c) Evaluate the operation/emergency procedures and training requirements.

(LL) Construction Standards and Codes.

(1) Requirements. Unless modified elsewhere in these Contract Documents, the installation of signals and train control equipment shall be governed by the latest provisions of the NEC Standard of the National Board of Fire Underwriters for Electrical Wiring and Apparatus, the AREMA Communications and Signals Manual, MUTCD, FRA rule 234 and all other applicable codes. All provisions of these Codes shall be considered applicable whether or not specifically mentioned in these Contract Documents.

(MM) Coordination of the Work.

(1) Requirements. The Contractor shall submit an installation and cut-over sequence plan. The plan shall be submitted prior to commencing any field installation work, and shall include, at a minimum, the following:

(a) Narrative descriptions and schematics to maintain existing train operations and headways.

(b) Narrative descriptions and schematics for temporary or interim circuits and materials.

(c) Narrative descriptions and schematics for final circuits and materials.

(d) Descriptions for the implementation and sequencing of all required tests.

(2) Interface Requirements, roadway traffic signal pre-emption.

(a) A junction box will be provided on the side of the Signal Case to interface with the roadway traffic signal cable.

(3) Submittal Requirements.

(a) A sequence plan for installation, testing, and cut-over shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(NN) Clearance.

(1) Requirements. For the installation of wayside equipment, the Contractor shall be responsible to provide adequate clearance in relation to the dynamic outline of trains, utility equipment clearance, signal sighting distances, and obstructions and access by maintenance personnel.

(OO) Electrical Connections.

(1) Terminals. These requirements for electrical connections shall apply to factory and field wiring. All wires which are terminated on AREMA binding posts shall be fitted with an acceptable insulated crimped type terminal as described in AREMA Communications and Signal Manual, Part 14.1.1. These terminals shall be placed on the wire by means of standard forming tools of the proper size, equipped with locks to assure that the proper pressure is applied before the tool is released. Care shall be taken to assure that the correct size of wire terminal is used and that the wire is thoroughly cleaned and centered properly in the wire terminal when using the forming tool.

(2) Stripping of Wires. Wire terminals shall not be bent, nicked or otherwise damaged. An acceptable wirestripping tool shall be carefully used to remove the insulation from No. 9 AWG and smaller wires. Scraping of these conductors with any sharp instruments shall not be permitted. For wires larger than No. 9 AWG, a knife may be used to remove the insulation, extreme care being taken to prevent nicking the conductors.

(3) Wire Connections. Connections to bases for plug-in relays and similar connections to lever and lamp contacts shall be soldered or crimped using a connector.

(4) Submittal Requirements.

(a) Terminals, crimping and strip tools, and wire connectors proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(PP) Painting.

(1) Requirement. All painting and other coating shall be furnished and applied as specified herein.

(2) The painting and coating of materials and equipment furnished under these Contract Documents shall comply with the requirements of the AREMA Communications and Signal Manual, Part 1.5.10, insofar as they apply and except as hereinafter modified. With the exception of galvanized and plated surfaces, machined surfaces, wires and cable, bolts and nuts for field assembly and other similar surfaces and materials, all materials and equipment to be furnished under this Contract shall be cleaned and painted in the factory with one (1) prime coat and one (1) finish coat. All equipment shall be touched up after installation.

(3) Brand. Paints for primer and finishing coats shall be a recognized acceptable proprietary brand.

(4) Application. No paint shall be applied on wet, damp, frosted or dirty surfaces, or when the temperature of the air is below forty (40) degrees Fahrenheit.

(5) Inaccessible Surfaces. Surfaces required to be painted and which shall be inaccessible after installation or erection shall be given two (2) additional coats of paint before installation or erection.

(6) Damage. If any surface, which has been painted, is damaged prior to the completion of the work under this Contract, such damaged surface shall be cleaned, touched-up, or completely repainted by the Contractor at no additional cost to the Contract.

(7) Submittal Requirements.

(a) Paints, including spray paints used for touch-up, shall be submitted to the Owner, or the designated representative of the Owner, for approval. Submittals shall be made as described in the appropriate section of this specification.

(QQ) Stenciling and Marking of Equipment.

(1) Identification. Instrument cases, equipment and junction boxes shall have the name of each individual piece shown directly on the respective door, cover, or frame by means of permanently stenciled lettering.

(2) Milepost and DOT Crossing Number. The Contractor shall be responsible for assuring that the Milepost and the DOT Crossing Number are stenciled on the roadway side of the signal house. Stenciled identifications shall be in black paint in letters five inches tall.

(RR) System Delivery Requirements.

(1) Scope. The contractor shall provide fully tested, functional, signal system. Equipment and materials used shall have individual certificates of conformance proving that they have been fully tested and proven acceptable. Field testing shall provide validation of system function.

(2) Factory Testing. Factory Testing shall include, but not be limted to, the testing described. All tests shall be documented on an approved testing form.

(a) Relay Test. All vital relays shall be factory testing in accordance with AREMA Communications and Signals Manual, Parts, 6.4.1.

(b) Equipment Functional and Operating Tests. Perform testing on the following equipment items to verify the proper setup, function, and operation of each:

1. Vital Relays

2. Constant Warning Time Device and associated equipment

3. Event Recorder

4. Power Supplies

(c) Signal Case Wiring. Factory wired Signal Case shall be tested as described below:

1. All factory wiring shall be continuity tested. The continuity test shall be done with a buzzer and appropriate battery. During this test, all tagging shall be checked and verified. The set of plans used to wire

the Signal Case shall be used during this test. As each wire is tested it shall be marked off in green on the plans. When all wires on a page have been marked in green, the tester shall signa and date the page.

2. A wire count shall be performed to verify that the number of wires that are connected to terminals posts, relay plug boards, and other termination points are in accordance with the approved wiring plans.

3. All vital and non-vital wiring shall receive a complete circuit breakdown test. Each relay contact shall be opened, the appropriate relays and processor inputs shall be observed to drop, and the appropriate signal equipment shall be observed to respond as intended. The correct operation of each break point shall be noted on the plans with a check mark. When all breaks on a page have been checked off the test shall sign and date the page.

(3) Field Testing. Field Testing shall include, but not be limited to, the testing described. All tests shall be documented on an approved testing form.

(a) Interior and exterior condition of the equipment shall be verified with discrepancies, and corrections, noted on a discrepancy form. Minor discrepancies in fit and finish may be repaired; however, major discrepancies shall be grounds for rejection of material. The Owner has final judgment of the suitability of equipment. The Contractor shall replace rejected equipment at no additional cost to the project.

(b) Energized Electrical. The Contractor shall test all energized electrical systems in the Equipment Case noting discrepancies, and corrections, on a discrepancy form. All discrepancies shall be corrected.

(c) Ground Testing. A test for grounds shall be performed on each energy bus furnishing power to circuits that affect the safety of warning system operation. All circuits shall be free of grounds.

(d) Flashing Light Units and Lamp Voltage. Flashing light units shall be inspected for proper alignment and frequency of flash. Lamp voltage shall be tested.

(e) Insulation Resistance Tests. Insulation resistance tests shall be made between all conductors and ground, and between conductors in each multiconductor cable. Insulation resistance of conductors to ground, or conductor to conductor shall not be less than 40 megohms. Insulation resistance testing shall be made using a James Biddle Major Megger Insulation Tester Type 21159, or an approved equivalent.

(f) Insulated Joints, Bonds and Track Connections. Insulated joints, bond wires and track connections shall be inspected. Discrepancies shall be corrected. Approach distances shall be wheeled off and noted against the Contract Drawings.

(g) Constant Warning Time Device Setup. The constant warning time device shall be setup per the recommendations of the manufacturer. Testing shall confirm that a 0.06Ω track shunt is detected by the device. Lumped impedance adjustment, narrowband termination compensation, and 50% and 100% approach distance shunt values should all be tested.

(h) System Operation.

1. Observe two trains in each direction over the constant warning device track. Confirm that the crossing system operates as expected and that no tail ringing occurs as the trains recede from the crossing. Observe the operation of the constant warning time device as the trains approach and recede and verify that the track levels rise and fall in a linear manner. Note discontinuities in the approaches and investigate to determine if rail connections and rail bonds are in good condition in those areas of the track. The results of all testing shall be captured on testing forms. Discrepancies shall be corrected before the crossing is signed into service.

2. Track circuit operation. All track circuits shall be tested to assure that they are correctly setup and that the track relay, or equivalent of the track relay, deenergizes when a 0.06Ω shunt is placed across the track circuit.

3. The results of all testing shall be captured on testing forms. Discrepancies shall be corrected before the crossing is signed into service.

(4) Submittal Requirements. Submittals shall be made as described in the appropriate section of this specification.

(a) The test plan and test forms proposed for use shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(b) Following the factory testing, completed test forms and marked up set of wiring plans shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(c) Following the field testing, completed test forms shall be submitted to the Owner, or the designated representative of the Owner, for approval.

(SS) System Required Testing.

(1) Testing shall be performed as directed by MUTCD Part 8, and FRA Rules 234 and 236 (as applicable). All testing shall be recorded on testing forms. Discrepancies shall be corrected before the crossing is signed into service. Testing shall include, but not necessarily be limited to, the following tests:

(a) FRA 234.211. Security of warning system apparatus. Assure that all apparatus and housings are secured against unauthorized entry. Testing forms shall record that locks have been installed as required.

(b) FRA 234.249. Grounds. Assure that each circuit that affects the proper functioning of a highway grade crossing warning system is free of any ground, or combination of grounds, that would permit a current flow of 75% of more of the release value of any relay or electromagnetic device in the circuit. Relief from this requirement shall only be provided as described in the text of this rule. Testing forms shall record the results of all ground testing.

(c) FRA 234.251. Standby Power System. Assure that the standby power system is capable of operating the highway grade crossing warning system in the event of an interruption to the primary power system and further assure that the capacity of the standby power system is correctly

recorded on the plans. Testing forms shall record the results of the standby power system testing.

(d) FRA 234.253. Flashing light and lamp voltage. Warning Aspect. Assure that the flashing light units are properly positioned and aligned, and are visible at least 300 feet from the crossing on a bright day with the sun near its zenith. Light units shall flash alternately at a rate of 35 to 55 flashes per minute. Hoods and backgrounds shall be provided for all lights. Roundels and reflectors shall be clean and in good condition. Lamp voltage as measured at the farthest light from the crossing shall not be less than 85% of the prescribed rating for the lamp. Testing forms shall record the results of the flashing light and lamp voltage testing.

(e) FRA 234.255. Gate arm and gate mechanism. Assure that the gate arm movement properly operates. Testing forms shall record the results of the gate arm testing.

(f) FRA 234.257. Warning system operation. Assure that the crossing warning system, including warning bells, function properly. Testing forms shall confirm the proper operation of the warning system and the warning bells.

(g) FRA 234.259. Warning time. Length of Circuit. Assure that normal trains provide a minimum of 20 seconds of warning time. In no case shall a normal train provide less than 20 seconds of warning time. Testing forms shall record the length of the approach tracks as measured from the track connections at the crossing, and the warning time for trains approaching the crossing from both directions.

(h) FRA 234.261. Highway traffic signal pre-emption. Traffic Signals Near Grade Crossings. The Contractor shall assure that pre-emption circuits work as described in the Contract Drawings.

(i) FRA 234.263. Relays. Test all new relays installed as a part of this project to assure that they function per their manufacturer’s specifications. Certificates of Conformance, as provided by the manufacturer, shall be included as part of the testing documentation. Testing forms shall record the results of all relay testing.

(j) FRA 234.265. Timing relays and timing devices. No testing is required for the timing functions of the constant

warning time devices and the solid-state crossing controllers beyond that previously described in this section.

(k) FRA 234.267. Insulation resistance tests, wires in trunking and cables. Insulation resistance testing shall be performed on all cables. Newly installed cables shall have an insulation resistance of 40 Megohms, either conductor to conductor, or conductor to ground. Insulation resistance testing shall be made using a James Biddle Major Megger Insulation Tester Type 21159, or an approved equivalent. Testing forms shall record the results of all insulation resistance testing.

(l) FRA 234.269. Cut-out circuits. The Contractor shall test the circuits switch position override circuits for the crossings. Testing forms shall record the results of all override circuits.

(m) FRA 234.271. Insulated rail joints, bond wires, and track connections. The Contractor shall inspect all insulated rail joints, bond wires and track connections. Testing forms shall record the results of such inspection.

(n) FRA 234.201. Location of plans. Plans required for proper maintenance and testing shall be kept at each highway-rail grade crossing warning system location. Plans shall be legible and correct.

(o) FRA 234.209. The normal functioning of any system shall not be interfered with in testing or otherwise without first taking measures to provide for safety of highway traffic that depends on normal functioning of such system.

(p) FRA 234.227. Train detection apparatus. Train detection apparatus shall be mainted to detect a train or railcar in any part of a train detection circuit, in accordance with the design of the warning system.

(q) FRA 234.229. Shunting sensitivity. Each highway-rail grade crossing train detection circuit shall be to shunt at 0.06Ω. Test and record the shunting sensitivity of each track circuit.

(r) FRA 234.231. Fouling wires shall be installed as required.

(s) FRA 234.233. Rail Joints. Each non-insulated rail joint located within the limits of a highway rail grade crossing train detection circuit shall be bonded by means other than joint bars and the bonds shall be maintained in such condition to ensure electrical conductivity.

(t) FRA 234.239. Each wire shall be tagged or otherwise so marked that it can be identified at each terminal.

(TT) Submittal Requirements.

(1) Scope. Submittals shall be made as directed by this specification and as detailed in the Contract Documents Requirements Listing (CDRL) table following.

(2) Format. Submittals shall provide sufficient information to allow the reviewer to determine that they are suitable for the purpose for which they are proposed. Cut sheets or shop drawings shall be provided for all equipment or materials submitted. Where more than one item is shown on a cut sheet or drawing, some means such as cross-out or highlighting shall be used to indicate the item being submitted.

(a) Submittals shall be made on 8 ½" x 11" paper. Where cut sheets or drawings are larger than this, they shall be folded to an 8 ½" x 11" size.

(b) 3 copies of each submittal shall be provided to the Owner, or the designated representative of the Owner. Submittals shall be accompanied by a transmittal that clearly identifies the submittal by specification section and description. Transmittals shall also provide the date that the submittal is made, and the contact information of the individual responsible for making the submittal.

(c) The Owner, or the designated representative of the Owner, shall review the submittal packages and shall return 1 copy of the package to the Contractor within 15 working days of its receipt. The package shall be accompanied by a transmittal identifying the package and providing the following information:

1. ACCEPTED. Submittal accepted without comment. Submitted item may be used in the work.

2. REJECTED. Submittal rejected. Comments provided with the rejection notice, including comments

written on the submittal sheets, will identify the deficiencies in the submission. Submitted item may not be used in the work. Item shall be resubmitted with deficiencies corrected.

(d) Items that require resubmission shall be subject to the same requirements as the original submission. The Owner, or the designated representative of the Owner, shall return 1 copy of the resubmitted package to the Contractor within 10 working days of its receipt. The package shall be accompanied by a transmittal identifying the package and providing information as to its status.

660.04 Measurement. Railroad signal system will be paid on a lump sum basis. Measurement for payment will not apply.

660.05 Payment. The Engineer will pay for the accepted railroad signal system on a contract lump sum basis. Payment will be full compensation for the prescribed in this section and the contract documents.

The Engineer will pay for the following pay items when included in the proposal schedule:

Pay Item	**Pay Unit**
Railroad Signal System	Lump Sum

The Engineer will pay for the accepted hauling and stockpiling of salvaged materials and equipment off the right-of-way, as order by the Engineer, in accordance with Subsection 104.02-Changes."

END OF SECTION 660

Make the following section a part of the Standard Specifications:

"**SECTION 661 - RAILROAD TRACK CONSTRUCTION**

661.01 Description. This section describes new ballasted railroad track construction and track rehabilitation.

Construction of this Project (Ft. Barrette Road At-grade Crossing) shall be coordinated with Steve Vendt of the Hawaiian Railway Society (HRS) for both railroad operating schedule and construction oversight (808-681-5461). Construction of the crossing shall be performed during weekdays (M-F). The track shall be in service for all scheduled trains and maintenance operations. Contractor shall notify HRS at least two weeks prior to any track construction activities.

The Contractor shall notify the State of Hawaii, Department of Land and Natural Recourses (attn: State Historian) prior to completion of this project, so that a final field inspection can be carried out.

(A) Definitions.

(1) AREMA: American Railway Engineering and Maintenance-of-Way.

(2) FRA: Federal Railroad Administration.

(3) HRS: Hawaiian Railway Society

(4) MUTCD: Manual of Uniform Traffic Control Devices

(5) HDOT: State of Hawaii, Department of Transportation

(6) SHPD: State of Hawaii, Department of Land and Natural Resources, State Historic Preservation Division.

(7) Track: Railroad section consisting of rails, ties, ballast and OTM (measured in TF).

(8) Rail: Singe rail (measured in LF and tons).

(9) TF: Track feet.

(10) OR&L: Oahu Railway & Land Co.

(11) OTM: Other Track Materials defined as miscellaneous items used in Track Construction including but not limited to tie plates, tie pads, spikes, anchors, joint bars, bolts, nuts, washers, rail clips, etc.

(12) Roadbed/Subgrade: Surface of graded embankment or cut section below the ballast and/or subballast section.

(B) Quality Assurance.

(1) Referenced Standards:

(a) American Railway Engineering and Maintenance-Of-Way Association (AREMA):

1. 2018 Manual for Railway Engineering (hereinafter referred to as AREMA Manual).

(2) American National Standards Institute (ANSI):

(a) CP-189,Standard for Qualification and Certification of Nondestructive Testing Personnel.

(3) ASTM International (ASTM):

(a) C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

(b) C117, Standard Test Method for Materials Finer than 75-μm (No. 200 Sieve in Mineral Aggregates by Washing.

(c) C127, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Ag.

(d) C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

(e) C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.

(f) C142, Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

(g) C535, Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

(h) C702, Standard Practice for Reducing Samples of Aggregate to Testing Size.

(i) D75, Standard Practice for Sampling Aggregates.

(j) D3776, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

(k) D4354, Standard Practice for Sampling of Geosynthetics for Testing.

(l) D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

(m) D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

(n) D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

(o) D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

(p) D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

(q) D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

(r) D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

(s) D4759, Standard Practice for Determining the Specification Conformance of Geosynthetics.

(t) D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

(u) D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

(v) F512, Standard Specification for Smooth-Wall Poly Vinyl Chloride (PVC) Conduit and Fittings for Underground Installation.

(4) American Welding Society (AWS):

(a) D1.1, Structural Welding Code - Steel.

(5) American Wood-Preservers' Association (AWPA):

(a) U-1 & T-1 Category System Standards, Crossties and Switch Ties – Conditioning and Preservative Treatment by Pressure Processes.

(b) M2, Standard for Inspection of Treated Wood Products.

(c) M6, Brands Used on Forest Products.

(d) P2, Standard for Creosote Solutions.

(6) Federal Railroad Administration (FRA):

(a) Title 49 Part 200 - Part 399 - Transportation.

(7) U.S. Federal Highway Administration (FHWA):

(a) SA-89-006, Manual on Uniform Traffic Control Devices for Streets and Highways.

(C) Submittals.

(1) Shop Drawings:

(a) See Section 106 – Control of Material for requirements for the mechanics and administration of the submittal process.

(b) As-built drawings.

(c) Product data:

1. Wood ties: Name of the tie manufacturer, Rail Tie Association membership, the wood species proposed, the quantities of ties for each specie proposed, and product data for the ties to be furnished, including the type of seasoning to be utilized, prior to ordering the ties.

2. Relay rail, joint bars, insulated joint bars and compromise joint bars:

a. For relay rail the required information shall include weight, section, lengths, and the name of the supplier.

b. The maximum allowable vertical wear on the rail head and the maximum allowable horizontal wear on the side of the rail shall be provided.

c. The design of the joint bars and compromise joint bars proposed to be furnished with each rail section shall also be provided.

3. Miscellaneous track materials: Manufacturer's data for all track materials to be furnished.

4. Crossing material or surface: Within 30 days of the Notice to Proceed, the brand name of the premanufactured crossing material or crossing surface material proposed for use along with manufacturer's literature concerning the product including installation procedure; and for built-in-place crossings, the type of materials to be used along with manufacturer's literature.

5. Thermite welding procedures:

a. A detailed statement covering the step-by-step procedures to be employed in making the welds, including a complete description of each of the following items, as applicable, and any other essential characteristics included in the welding procedures:

i. The manufacturer's trade name for the welding process.

ii. Quality control procedures to be followed.

iii. The contractual agreements with any subcontractor employed by the Contractor in doing the Work.

(d) Samples:

1. Ballast and subballast:

a. Samples of the ballast and subballast for testing.

b. Samples shall be submitted a minimum of 30 days prior to the installation of the material.

c. Samples shall be obtained from the quarry, supplier, or other source that will be used to provide the ballast and subballast materials for this Project using the methods described in ASTM D75.

(e) Test reports:

1. Sampling and testing: One certified copy of Test Reports for each test performed on the ballast and subballast within 2 working days of the test completion.

2. Wood ties:

a. Certified test and inspection reports for crossties and switch ties subsequent to treatment, a minimum of seven calendar days prior to any ties being installed in track.

b. Test and inspection reports shall contain the information required by Part 7 of AWPA M2.

3. Ultrasonic test:

a. Results of the ultrasonic rail testing.

b. Results shall list defects and rail stationing.

(f) Certificates:

1. Wood ties: Certificates of compliance prior to any ties being installed in track.

2. Ballast and subballast: Certificates of Compliance for the ballast and subballast materials to be installed in this Project.

3. Materials and samples: Manufacturer's certificates of conformance for the following materials:

a. Rail.

b. Tie plates.

c. Track bolts, nuts, and spring washers.

d. Joint bars.

e. Rail anchors.

f. Track spikes

g. Rail welding process.

h. Premanufactured road crossings and/or crossing surfaces.

(D) DELIVERY, STORAGE, AND HANDLING

(1) Materials and Samples:

(a) The Engineer will notify the Contractor of the materials approved or disapproved.

(b) Disapproved materials that have already been delivered to the Project site, shall be promptly segregated from the approved materials and removed from the premises.

(c) If materials are disapproved, acceptable replacement materials shall be provided at no additional cost to the Owner.

(d) Initial approval by the Engineer will not prevent the removal and replacement of materials that are materially defective or materials not meeting this specification that are discovered during construction and/or routine quality control/quality assurance operations.

(2) Geotextiles:

(a) Geotextiles shall be shipped and stored in their original ultraviolet resistant cover until the day of installation.

(b) Geotextiles shall be protected from vandalism, temperatures greater than 140 degrees Fahrenheit, dirt, dust, mud, debris, moisture, sunlight, and ultraviolet rays.

(c) Geotextiles delivered to the Project site shall be clearly labeled on the material cover to show the manufacturer's name, brand name, fabric type, location and date manufactured, lot identification, width, and length.

(E) Qualifications

(1) Track Construction: Track construction shall be performed under the direction of qualified and competent supervisory personnel experienced in railroad construction, with a minimum of 10 years of railroad construction experience.

(2) Rail and Bond Welding: Welding shall be performed under the direct supervision of an experienced welding supervisor or foreman, with at least 5 years of experience with welding of railroad track.

(F) Project/Site Conditions

(1) Temporary Work:

(a) During construction, suitable roads and crossings with all necessary lights, signs, drainage, and other appurtenances required for safe public and local travel shall be provided.

(b) Suitable temporary fences shall be erected and maintained where required to prevent trespass upon work or damage to adjoining property.

(c) Drainage shall be maintained, and the accumulation of water that might affect the stability of the roadbed will not be permitted.

661.02 Materials.

(A) Salvaged Materials

(1) Dunnage:

(a) Pallets, sills, and other material used for packaging and stacking salvaged track items shall be clean, free of decay or other defect, and sufficiently sturdy for the service intended.

(2) Marking Paint:

(a) Marking paint shall be a good quality oil-based spray marking paint or a good quality oil-based paint marker.

(3) Salvaging Rail:

(a) The Contractor shall salvage rail as directed; the Owner will make available salvaged rail to the Contractor subject to the following:

1. Nondefective and reclaimable rails salvaged from existing tracks may be used to execute spot rail replacement work at other locations of the Project, subject to review and approval of the materials by the Engineer.

2. Reclaimable defective rails may be used to construct guardrails provided all defects can be cropped off.

a. Detailed inspection shall be made of such rails to ensure that rails which contain critical defects such as transverse defects, head-web separations, vertical split heads, pipe, split webs, etc., are not incorporated in the work.

b. Loose rails located along the right-of-way shall be inspected and used as directed.

(4) Joint Bars:

(a) Nondefective joint bars salvaged from existing tracks may be used to execute spot replacement work at other locations of the Project, subject to review and approval of the material by the Engineer.

(5) Tie Plates:

(a) Tie plates salvaged from existing tracks, which are not broken, cracked, or severely corroded or worn, may be used to execute the work subject to review and approval of the material by the Engineer.

(B) Ballast

(1) Prepared ballast shall be crushed stone, Size No. 4 conforming to AREMA Manual, Chapter 1, Part 2, for quality, soundness and gradation.

(2) Ballast materials shall meet the property requirements shown in TABLE I.

TABLE I. MINIMUM PROPERTY REQUIREMENTS - BALLAST

PROPERTY	MAXIMUM VALUE	MINIMUM VALUE	TEST METHOD
Percent passing No. 200 Sieve	1.0 percent		ASTM C136 ASTM C117
Bulk specific gravity Rock		2.60	ASTM C127
Absorption Rock	2.0 percent		ASTM C127
Clay lumps and friable particles	0.5 percent		ASTM C142
Degradation	35 percent		ASTM C535
Soundness Sodium sulfate - 5 cycles	10 percent		ASTM C88
Flat or elongated particles	5 percent		ASTM D4791

(3) Crushed No. 4 Coral shall be used for the top 2-in in open track.

(C) Subballast

(1) Subballast shall consist of aggregate-soil materials conforming to Section 304 – Aggregate Base Course and Section 703.06 – Aggregate for Untreated Base.

(D) Cement-Treated Permeable Base

(1) Cement-Treated permeable base used outside of railroad ties shall conform to Section 309 – Portland Cement Treated Permeable Base.

(E) Geotextile

(1) Physical Property Requirements:

(a) The geotextile shall be composed of woven high-tenacity microfilament polypropylene yarns.

(b) The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed.

(c) The geotextile shall contain stabilizers and/or inhibitors as necessary to make the filaments resistant to deterioration from ultraviolet light and heat exposure, particularly prior to placement and coverage.

(d) The fibers shall be formed into a network which will be dimensionally stable.

(e) The edges of the geotextile shall be finished in a way to prevent the outer fibers from being pulled away from the geotextile.

(f) The geotextile shall exceed the applicability property requirements stated in TABLE II.

(F) TABLE II. PROPERTY REQUIREMENTS - GEOTEXTILE

PROPERTY	MINIMUM REQUIREMENTS *	TEST METHOD
Grab tensile elongation	21%	ASTM D4632
Grab tensile strength	350 LBS	ASTM D4632
CBR puncture strength	1,340 LBS	ASTM D6241
Trapezoidal tear strength	125 LBS	ASTM D4533
Apparent opening size (AOS) (maximum required valve)	Less than 0.425 mm (No. 40)	ASTM D4751
Normal permeability (k)	4.75 cm/sec	ASTM D4491
Permittivity	0.96 per sec	ASTM D4491
Ultraviolet degradation at 500 hours	90 percent strength retained	ASTM D4355
Percent open area	6%	

* These property requirements are Minimum Average Roll Values in the weaker principal direction.

(2) Dimensional Requirements:

(a) Each roll of Geotextile shall span the entire width of the roadbed and be at least 12 FT.

(F) Geogrid

(1) Physical Property Requirements:

(a) The Geogrid shall be a polypropylene material and shall consist of geometric triangles and shall conform to Section 321 – Triaxial Geogrid.

(b) The Geogrid shall be placed to provide stability in the railroad ballast.

(2) Dimensional Requirements:

(a) Each roll of Geogrid shall span the entire width of the roadbed and be at least 12 FT.

(G) Wood Ties

(1) All ties shall be new.

(a) Species shall be new oak or an approved equal per AREMA 5-4.1l (1)

(b) All crossties shall be AREMA approved hardwood.

(c) Conditioning and seasoning shall conform to the requirements of AWPA StandardU-1 for the individual wood species.

(d) Ties shall be well seasoned.

(e) Prior to preservative treatment, wood ties shall be dried to the oven dry moisture content, or less, as specified in AWPA Standard U-1.

1. The wood may be air dried, vapor dried, or boultonized.

2. Ties which are to be dried by artificial means shall be conditioned and treated as soon as possible after sawing, but no more than 30 days later.

3. The temperature used for boultonizing shall be as high as possible but in no case less than 200 DegF.

4. Vapor dried ties shall be transferred from drying cylinders to treatment cylinders as quickly as possible to avoid loss of heat from the seasoned ties.

(f) Ties shall be pressure treated in accordance with AREMA Manual, Chapter 30, Part 3, by the empty cell process with a 60/40 creosote/coal tar solution in accordance with AWPA P2 to a minimum retention of7 LBS/CF of wood.

(g) The Contractor shall record treatment as specified in AWPA M2.

(h) Treated ties shall be permanently marked or branded by the producer in accordance with AWPA M6.

(i) Ties shall be produced by a member of the Railway Tie Association.

(j) All ties shall be incised on all four sides in the pattern specified in AREMA Manual, Chapter 30, Part 3, prior to treatment.

(k) Splits shall not be longer than 4 IN and not wider than 1/4 IN at either end.

1. Splits longer than 4 IN but not longer than the width of the face in which the split appears, will be acceptable if specified anti-splitting devices are installed with the splits compressed.

(l) Any required adzing and drilling for spikes shall be performed prior to treatment.

(m) Crossties shall be sawed and shall be not less than 7 IN thick and 7 IN wide and shall be to the lengths indicated in the drawings.

(2) Tie Plugs:

(a) Tie plugs shall fit holes from which spikes are drawn. The plugs shall comply and be treated in accordance with AREMA Manual, Chapter 30, Part 3, Section 3.1.5.

(3) Anti-Splitting Devices:

(a) Crossties and switch ties shall be equipped on each end with gang nail end plates anti-splitting devices of the type specified, regardless of whether or not the wood has shown any tendency to split.

(b) Products used shall conform to AREMA Manual, Chapter 30, Part 3, Sections 3.1.6 and 3.1.7.

(H) Rail.

(1) Used Rail:

(a) Relay rail:

1. Relay rail shall. not have internal defects. Rail for the crossing shall be Contractor furnished 90 ARA-A section. All other rail shall be the existing 60 ASCE.

2. All the 90-lb rail shall be continuous welded rail.

a. Rail drilling:

i. The ends of the 90-lb rail where it transitions to 60-lb rail shall be drilled to accommodate a compromise joint.

ii. Drilling shall be uniform and to the patterns specified.

RAIL	DRILLING
90#	5 X 2.5 in.

b. Length:

i. No sections of the crossing rail shall be less than 13 FT between welds.

c. Maximum allowable wear:

i. For each rail, the average top wear shall meet the requirements on TABLE IV.

ii. Side wear shall be measured 5/8 IN below the original top of rail.

d. Condition and appearance:

i. Relay rail shall be free from obvious defects and clean in appearance.

i. Rail shall be straight from line and surface and free from any kinks or bends.

ii. Rail bases shall be solid and free from visual defects such as plate wear, spike notching, pitting, and flame-gouging.

iii. All existing bond wires shall be removed from relay rail by shear cutting old cables immediately adjacent to the weld or pin.

iv. Bond wire heads shall be completely removed from the gage side.

e. Maximum allowable lip: Lip or overflow shall not exceed 1/8 IN on either side of the rail head.

f. Engine burns:

i. Engine burns shall not be greater than 1/2 IN DIA and 1/32 IN deep.

ii. A maximum of 6 engine burns is allowed per rail and engine burns shall not affect more than 25 percent of the total order.

f. End batter and chipping:

i. Rail end batter shall not exceed a maximum of 1/8 IN when measured 1/2 IN from the rail end with an 18 IN straightedge laid only on the rail being measured.

ii. Chipped or broken rail ends will not be accepted.

g. Running surface damage:

i. Running surface damage shall not exceed 1/2 IN long by 1/2 IN wide, and shall be not greater than 1/32 IN deep.

ii. Flat spots are not permitted on the rail head.

h. Defects not permitted:

i. Relay rail having any of the following defects shall not be accepted:

a) Bolt hole cracks or breaks, broken base, breaks, crushed head, detail fracture, engine burn fracture, head-web separation,

piped rail, horizontal split head, vertical split head, torch cut rail ends, torch cut bolt holes, and compound or transverse fissures.

b) The presence of any of these defects in the rail renders that rail as scrap.

Table IV. Allowable Wear Limits For Relay Rail		
Nominal Rail Weight, lbs/yd	Maximum Allowable Wear, IN	
	Top	Side
90	1/8	3/8

(I) Grade Crossings

(1) Crossing Material or Surface:

(a) Roadway width shall be as indicated in the Contract Drawings. Crossing material or surface shall comply with the following:

1. Premanufactured, precast concrete panels for grade crossings shall be constructed of reinforced concrete having a minimum 28-day compressive strength of 5,000 psi.

a. Each panel shall be manufactured to meet HS20-44 loading in accordance with AASHTO HB-16, with 30 percent impact increment.

b. Loading shall be based on single axle loads of 32,000 LBS.

c. Precast crossing panels shall be as manufactured by OMEGA Industries of Vancouver, WA or approved equal.

(2) Rail:

(a) Rail within the road crossing and beyond either side of the crossing as shown in the contract drawings shall be continuous welded rail (CWR) 90 ARA-A as specified in Paragraph “Rail and Joint Bars.”

(3) Ties:

(a) Ties within the road crossing and beyond each end of the crossing as shown in the contract drawings shall be hardwood and shall not be less than 7 IN thick and 9 IN wide.

(b) The length shall be 8 FT.

(4) Track Materials:

(a) or premanufactured crossing surfaces or systems, tie plates, spikes or other rail fasteners, rail anchors, and other track materials shall conform to the manufacturer’s recommendations.

1. Unless specified by the crossing manufacturer, track materials shall be as specified in Paragraph “Miscellaneous Track Materials.”

(5) Threaded Fasteners and Screw Spikes:

(a) Threaded fasteners for use in grade crossings shall be of the sizes and lengths specified by the grade crossing manufacturer or as indicated for built-in-place crossings.

1. Screw spikes shall have a minimum ultimate tensile strength of 60,000 psi and shall be galvanized for corrosion protection.

(6) Pipe for Subdrains:

(a) Pipe for subdrains shall be 4 IN DIA smooth sided, perforated polyethylene complying with ASTM F405, Schedule 80 Pipes connections exiting the ballast shall be smooth sided non-perforated.

(7) Signal Conduit:

(a) Signal conduit under grade crossings shall be 4 IN DIA PVC pipe conforming to ASTM F512, and shall be a minimum of Schedule 80.

(J) Other Track Materials (OTM)

(1) Spikes:

(a) Track spikes:

1. Track spikes shall be new and shall conform to AREMA Manual, Chapter 5, Part 2.

a. Track spikes size 6 IN by 5/8 IN.

(2) Bolts, Nuts, and Spring Washers:

(a) New track bolts, nuts, and spring washers shall be used throughout the Project for all rail.

1. Bolts and nuts:

a. The various rail, joint bars, and rail drillings require various lengths and diameters of bolt assemblies.

i. The Contractor shall determine the number of bolt assemblies of each size required.

ii. All bolt diameters shall be the largest possible for a given rail drilling and joint bar punching.

iii. Track bolts and nuts shall conform to AREMA Manual, Chapter 4, Part 2.

iv. Track bolts shall be long enough to leave at least two threads exposed after the nut is tightened.

2. Spring washers:

a. Spring washers and nuts shall be sized to ensure that the spring washer develops its full reactive force and does not jam into the joint bar hole.

i. Spring washers shall be of the size to fit the bolt and nut used and shall conform to AREMA Manual, Chapter 4, Part 2, and AREMA Track Work Plans, Section M12.

(3) Rail anchors:

(a) New installation:

1. Rail anchors for new installations shall be new.

a. Sizes shall conform to the various sizes of rail on the Project and conform to "Specifications for Rail Anchors" in AREMA Manual, Chapter 5, Part 7.

b. Anchors may be either drive-on or spring type.

(b) Salvaged rail anchors:

1. Rail anchors salvaged from the track being removed shall become the property of HRS and shall be removed from the site and delivered to the HRS yard east of the project site.

a. No used anchors shall be reinstalled.

(4) Insulated Joints:

(a) Insulated joints shall conform to applicable portions of AREMA Manual, Chapter 4, Part 2.

(b) Conventional continuous insulated joints with fiber insulation shall not be used.

(c) Unless otherwise directed by the Engineer, insulated joints shall be for the following rail sections, rail drilling, and number of joints:

RAIL SECTION	DRILLING	NO. JOINTS
60 ASCE	5 x 2-1/2	9

(5) Joint Bars:

(a) Joint bars shall be of the size, shape, and punching pattern to fit the rail being joined.

(b) Joint bars removed from existing track not used shall be salvaged and transported to the HRS yard east of the project site.

(c) Compromise joint bars:

1. Compromise joint bars shall be of the size, shape, and punching pattern to fit the rail sizes and sections being joined.

a. Only factory designed and constructed (forged or cast) compromise joint bars shall be used to join rails of different sizes.

(b) New compromise joint bars:

1. Compromise joint bars shall conform to the requirements of “Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars” found in AREMA Manual, Chapter 4, Part 2.

(c) Used compromise joint bars:

1. Requirements for joint bars in Paragraph “Used Joint Bars” shall also apply to used compromise joint bars.

(6) Tie Plates:

(a) General:

1. Tie plates shall be of the dimensions and punching pattern (A or B) to fit the rail.

2. Tie plates shall be Canted, 40:1.

(b) Used (or New) tie plates:

1. Used tie plates in good condition may be used and shall be the dimensions as originally specified by AREMA Manual.

a. The used tie plates shall not be smaller than 7-1/2 by 10 IN for use with relay rail having nominal weights less than 100 LBS/YD.

2. Used tie plates shall be free from excessive rust, pitting, mechanical damage, and dirt and other foreign materials.

a. Cracked or broken plates shall be considered as scrap and shall not be used.

b. Shoulders on the tie plates shall project a minimum of 1/4 IN above the plane of the rail seat.

c. The thickness of the tie plate shall be at least 1/2 IN when measured anywhere in the rail seat area.

d. Spike holes shall be square and not corroded, worn, or mechanically enlarged.

(K) Bonding.

(1) Rail Bonds:

(a) Rail bonds shall be exothermic type ("Cadweld") bonds applied to the field side of the rail head.

(b) The bond cables shall be flexible bare copper stranded 2/0 AWG cables with preformed ends.

(c) Bond cables shall be flexible bare copper stranded cables with preformed ends and shall conform to applicable requirements of AREMA Manual Vol. 3.

(L) Welding.

(1) Rail Welding Kits:

(a) Thermite type rail welds shall be made utilizing one of the following brands of rail welding kits or an approved equal:

1. Calorite, limited or standard preheat, as manufactured by Calorite, Inc., Addison, Illinois, and distributed by Portec, Inc., Railway Products Division, Oak Brook, Illinois.

2. Boutet, as distributed by DuWel Steel Products Company, Chicago, Illinois.

3. Orgo-Thermit, as distributed by Orgo-Thermit, Inc., Lakehurst, New Jersey.

(2) Electrodes:

(a) Provide AWS low-hydrogen, high tensile 140-16 (extrapolation) or 25-20 electrode, Grade 310-16 and 310-15 stainless steel rod welding electrodes.

(b) Provide electrodes of the smallest practical diameter worked at the lowest compatible current.

(c) Coating on low-hydrogen type electrodes shall be thoroughly dry when the electrode is provided.

(d) Use electrodes taken from hermetically sealed packages within one hour of the time the package is opened.

(e) Electrodes not used within this one-hour period and electrodes taken from non-hermetically sealed packages shall be dried for at least one hour between 700 and 800 DegF.

(f) Electrodes so dried may be stored at temperatures between 225 and 400 DegF until used, or, if not stored and not used within one hour after this drying is completed, shall be re-dried before use.

(g) Do not use electrodes which have been wet.

661.03 Construction.

(A) Removal, Salvage, and disposition of Materials

(1) Tracks and segments of track shall not be dismantled until approved to do by the Engineer.

(a) The following materials shall be salvaged by the Contractor for later use by the Owner.

(b) Some of these items will be used in the repair of tracks as indicated.

(2) Materials to be salvaged for later use by the Owner are:

(a) All existing salvageable track materials removed and not reused including but not limited to rail, spikes, joint bars, bolts assemblies, and crossties.

(b) All existing non-salvageable track materials removed and not reused including but not including rail, spikes, joint bars, bolt assemblies and crossties shall become the property of the Contractor and shall be removed from the Project.

(c) Other materials including removed ballast and subgrade shall become the property of the Contractor and shall be removed from the Project.

(3) Methods and Procedures:

(a) The Contractor shall dismantle the track in a manner to ensure the safety of the laborers and the general public, and no damage is caused to track components to be salvaged or other tracks and structures which are indicated to remain.

(b) Methods of removal of existing tracks shall not cause damage to adjacent sidewalks or paved roadways.

(c) Damage to these facilities caused by the Contractor shall be restored at Contractor's expense.

(4) Inventory of Track Materials:

(a) The Contractor shall keep a detailed inventory of excess and salvaged track materials stockpiled for the Owner.

(b) Detailed inventory shall be recorded in appropriate format and furnished to the Engineer.

(5) Inspection and Reconditioning of Used Track Materials:

(a) Salvaged track materials shall be cleaned and inspected for defects to determine their suitability for further use.

(b) Cleaning by hand or mechanical means:

1. Rail, joint bars, tie plates, rail anchors, and other materials shall be cleaned by hand or mechanical means to remove all adhering dirt and heavy rusting so that the bare steel can be examined.

(c) Visual examination of Track Materials:

1. Track Materials shall be visually examined for evidence of defects. Rails with defects or which cannot be reconditioned shall be rejected as scrap.

(6) Transportation of Salvaged Materials:

(a) Salvaged Track Material not used in track repair:

1. Excess and salvaged materials which are not used in track repair work shall be transported to the HRS yard approximately 0.6 miles east of the project site. These materials shall be stockpiled per the Engineer's direction.

(B) Ballast and Subballast

(1) Ballast {and subballast} shall be placed to the lines and grades indicated.

(a) The average thickness shall be within 0.25 IN of the thickness shown on the Drawings.

(b) Subgrade shall conform to the requirements of Section 203 –EXCAVATION AND EMBANKMENT.

(c) Ballast {and subballast} shall not be placed on soft, muddy, or frozen areas.

(d) Where the prepared subgrade (roadbed) is soft, muddy, rutted, exhibits severe depressions, or is otherwise damaged, the ballast {and subballast} shall not be placed until the damaged subgrade has been repaired and the area has been approved by the Engineer.

(2) Subballast:

(a) Subballast placement:

1. Subballast shall be placed in {two} uniform horizontal lifts of not more than 6 IN for the full width of the cross-section to the total depth indicated.

2. Each subballast layer shall be shaped to a section conforming to the subballast section shown on the Drawings and shall be thoroughly compacted.

(b) Subballast compaction:

1. Each subballast lift shall be compacted using approved compaction equipment.

2. The roller weights, vibration frequencies (where applicable), tire pressures (where applicable), and number of passes shall be sufficient to obtain in-place densities across the full width of the subballast and throughout the entire depth of the layer of not less than 95 percent of the ASTM D1557 laboratory maximum dry density for the subballast material.

3. Prior to placement of subsequent subballast layers the top of the previous layer shall be scarified to a depth of approximately 2 IN to insure proper bond of the layers

4. Density shall be field measured in accordance with ASTM D1556 (base plate, as shown in the Drawing shall be used) {or ASTM D2922}.

5. The calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in Paragraph “Calibration,” of the ASTM publication.

a. Tests performed in accordance with ASTM D2922 result in a wet unit weight of soil and, when using this method, ASTM D3017 shall be used to determine the moisture content of the soil.

b. The calibration curves furnished with the moisture gages shall also be checked along with density calibration checks as described in ASTM D3017.

c. The calibration checks of both the density and moisture gages shall be made by the prepared containers of material method, as described in Paragraph “Calibration,” in ASTM D2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

6. One field density test shall be taken for each 1,000 SQ YDS of each layer of material placed in each area.

(3) Ballast:

(a) Ballast placement:

1. AREMA Number 4 ballast shall be in the track as indicated on the Contract Drawings.

(b) Ballast distribution:

1. Ballast shall not be distributed until the subgrade and subballast has been approved by the Engineer. No payment will be made for ballast which is distributed without the Engineer’s approval.

a. Forming of ruts that would impair proper roadway drainage shall be prevented when distributing ballast from trucks and off track equipment.

i. Any ruts formed greater than 1 IN shall be leveled and graded to drain.

b. Ballast shall be unloaded as close as possible to the point of use so that unnecessary handling is prevented.

i. Excess ballast shall be picked up and redistributed at the Contractor's expense. If additional ballast is required for dressing, it shall be added by the Contractor at no increase in unit price.

(c) Ballast below ties:

1. For new construction, the last 4 IN ballast below the tie and the shoulder ballast shall be placed prior to the rail and tie installation.

2. For surfacing existing track, the ballast shall be placed subsequent to rail and tie replacements.

3. After open track has been surfaced, and lined and dressed using standard ballast, No.4 ballast, a layer of No.4 crushed Coral shall be placed on the top 2-in for final dressing as indicated in the Contract Drawings. Crushed coral shall NOT be used within the crossing area.

(d) Cement-Treated Permeable Base:

1. Placement:

a. The cement-treated permeable base shall be placed along the railroad ties though the crossing. Cement-treated permeable base shall not be placed between the ties.

(C) Track Construction

(1) Track construction not covered specifically herein shall be in accordance with AREMA recommendations and recommended practices.

(2) Roadbed Preparation:

(a) Roadbed surface, grade, and drainage shall be approved prior to any distribution of construction material.

(b) Where the subgrade or roadbed is damaged during distribution of materials, ruts and depressions shall be filled and compacted and the roadbed surface reapproved prior to track construction.

(3) Geotextile for Track Construction:

(a) Geotextile shall be installed between the subgrade and the ballast as shown in the Contract Drawings.

(b) Installation shall be in accordance with subparagraph Geotextile Installation under Paragraph “Road Crossings.”

(4) Geogrid for Track Construction:

(a) Geogrid shall be installed between the cement-treated permeable base and the ballast, as well as between the ballast and sub ballast through the grade crossing.

(b) Installation shall be in accordance with subparagraph Geogrid Installation under Paragraph “Road Crossings”.

(5) Unloading the Materials:

(a) The use of picks in the handling of ties will not be permitted.

(b) Rails of proper length shall be distributed as necessary for road crossings, switches, joint spacing, and other special conditions.

(6) Ties:

(a) Standard center-to-center spacing of crossties shall be 19.5 IN in open track and 18 IN in crossing track as shown in the contract drawings.

(b) Ties shall be laid perpendicular to the center line of the track with the grain up (heartwood side down).

(c) Adzing shall be restricted to that necessary to provide a sound true bearing for the tie plate.

1. Adzing in excess of 0.2 IN will not be permitted.

2. Where adzing is necessary, the cut surface shall be completely saturated with creosote or other approved preservatives.

(d) Tie Plates:

1. Crossing rail (90 ARA-A) shall be fully tie-plated.

2. Tie plates shall be free of dirt and other foreign material when installed.

3. Tie plates shall be placed so that the rails will have full bearing on the plate, and the plate will have full bearing on the tie.

4. Tie plates shall be set at right angles to the rail with the outside shoulder against the base of the rail, and centered on the tie.

5. Canted tie plates shall be installed to cant the rail inward.

(e) Rail:

1. The base of the rail and the surface of the tie and tie plate shall be free of dirt and other foreign materials prior to laying rail.

2. Laying rail:

a. Rail shall be laid without bumping or striking, to narrow gage (3 FT-0 IN between points 5/8 IN below the top of the rail) on tangents and on curves up to 12 degrees.

b. The track shall be gaged at every third tie as spikes are being driven.

c. Jointed rails shall be laid, one at a time, with space allowance for expansion being provided between rail ends in accordance with TABLE VI.

d. Gaps between rail ends in insulated joints shall only be sufficient to permit insertion of standard end posts.

e. A standard rail thermometer shall be used to determine the rail temperature.

i. The thermometer shall be laid close to the web on the side of the rail base which is shaded from the sun's rays in advance of the laying operation and left there long enough to accurately record the temperature.

ii. The Contractor's quality control representative shall see that rail temperature is checked frequently and that proper rail expansion shims are used.

iii. All thermometers shall be calibrated against the Engineer's rail thermometer which will have been accurately calibrated and will be considered as the standard.

3. Expansion allowance:

a. Allowance for expansion shall be provided at rail joints by using rail-expansion metal shims.

i. Shims shall be removed to within 12 rails of the laying.

ii. Shims shall be of the thickness shown in TABLE VI.

b. The temperature of the rail shall be determined by use of a thermometer placed on the rail base on the side away from the sun.

Table VI. Shim Thickness

33 Ft. Rail 160 Joins Per Mi.		39 Ft. Rail 135 Joins Per Mi.		78 Ft Rail 68 Joints per Mi.	
Rail Temperature (Degf)	Shim Thickness (In)	Rail Temperature (Degf)	Shim Thickness (In)	Rail Temperature (Degf)	Shim Thickness (In)
Below -10	5/16	Below 6	5/16	Below 35	5/16
-10 to 14	1/4	6 to 25	1/4	35 to 47	1/4
15 to 34	3/16	26 to 45	3/16	48 to 60	3/16
35 to 59	1/8	46 to 65	1/8	61 to 73	1/8
over 60	1/16	over 66	1/16	over 74	1/16

4. Cutting rail:

a. Only rail saws or track chisels shall be used to cut rail.

b. New holes shall be drilled using a standard template.

c. Holes shall not be burned in rail.

d. Holes cut with a torch will not be accepted.

e. When drilling of rail is necessary, all chips and burrs shall be removed before applying joints.

5. Matching rails:

a. Where relay rail is used, matching adjacent rails shall not cause lipped or uneven joints.

b. Any mismatched rail ends shall be welded to provide proper match.

c. Rail end mismatch shall not exceed 1/8 IN on gage or tread portions of rail.

(f) Joint Bars:

1. Joint bars shall be clean.

2. Bars shall be properly seated in the rail and the full number of correct-size bolts, nuts, and spring washers installed.

3. Bolts shall be placed with nuts alternately on inside and outside of rail.

4. A corrosion resistant lubricant shall be applied to the bolt threads prior to application of nuts.

5. Bolts shall be tightened to torque of approximately 250 FT-LBS beginning at the center of the joint and working both ways to the ends of the joint.

6. After the track has been in service {, but before acceptance of the work,} all bolts shall be checked and retightened to a torque of approximately 250 FT-LBS.

7. Defective joint bars designated on the Contract Drawings, discovered by the Contractor during track repair operations, or as identified by the Engineer shall be replaced with acceptable joint bars.

(g) Spiking:

a. Spiking procedures:

a. Rail shall be spiked promptly after being laid.

b. Spikes shall be started and driven vertically and square with the rail.

c. Spikes shall be driven to allow approximately 1/8 to 3/16 IN space between the underside of the spike and the top of the rail base.

d. Spikes shall not be overdriven, or straightened while being driven.

e. Spikes shall not be installed through the slots in skirted-type, slotted joint bars (angle bars).

f. Spikes shall not be driven against the ends of joint bars.

2. Number of spikes:

a. Four rail-holding spikes shall be used on each tie.

i. Spikes on the gage side of the running rail shall be placed directly across from each other and the spikes on the field side of the running rail shall be placed directly across from each other.

ii. This pattern shall be held consistent.

(h) Tie Plugs:

1. If spikes are withdrawn, the holes shall be swabbed with creosote and plugged with creosoted tie plugs of proper size to fit the hole.

2. If spikes are withdrawn and spikes are to be reinserted in existing spike holes, the holes shall be swabbed with creosote and plugged with creosoted tie plugs prior to redriving the spike.

3. Tie plugs shall not be installed in prebored holes unless spikes have been driven and withdrawn.

(i) Rail Anchor Placement:

1. Rail anchors shall be applied to box anchor every crosstie where the 90 ARA-A rail is installed. Do

not place anchors on crossties where 90 ARA-A rail is opposite 60 ASCE rail.

2. Rail anchors shall be installed to the gage side of the rail against the same tie face on opposite rails.

3. Rail anchors shall grip the base of the rail firmly and shall have full bearing against the face of the tie.

4. Rail anchors shall not be moved by driving them along the rail.

5. N/A.

6. N/A.

7. Rail shall be anchored immediately after spiking and before rail has experienced a large temperature change.

(j) Preliminary Surfacing:

1. The preliminary alignment shall follow the unloading of the ballast.

a. Lifts:

i. The track, after being aligned, shall be brought to grade and surface in lifts not exceeding 4 IN each.

ii. After each lift, the ballast shall be tamped.

iii. When using jacks, they shall be placed close enough together to prevent undue bending of rail or stress of rail and joint.

iv. Both rails shall be raised at one time and as uniformly as possible.

b. Tamping:

i. Raising and tamping of track shall be performed with an automatic, vibratory, squeeze type power tamper with 16 tamping heads, capable of raising both rails simultaneously and maintaining cross-level.

ii. The equipment to be used for surfacing operations is subject to approval by the Engineer.

iii. Every tie in the track shall receive two or more full insertions of the tamping heads.

iv. Ballast shall be power-tamped under both sides of ties from each end to a point {12 IN inside each rail.

v. The center shall be filled with ballast, but tamping will not be permitted in the center of the tie between the above stated limits.

vi. Both ends of the ties shall be tamped simultaneously and tamping inside and outside of the rail shall be done at the same time.

vii. Tamping tools shall not be used with more than 35 percent wear.

viii. All ties shall be tamped to provide solid bearing against the base of the rail after the track or turnout is raised to grade at final surfacing.

ix. All down ties shall be brought up to the base of rail and shall be machine tamped. The resultant track surface and alignment shall be uniform and smooth.

x. After tamping has been completed and the jacks removed, all ties pulled loose shall be replaced to their proper position, respiked and retamped to provide full bearing against the rail.

(k) Final Surfacing:

1. Surfacing and lining of existing track where indicated on the Contract Drawings shall be done similarly as described in this section for final surfacing and dressing of new track.

2. After preliminary surfacing has been completed, grade and line stakes shall be checked and the track brought to grade and alignment.

a. Final tamping:

i. Track shall be brought to grade and the ballast retamped in the manner described for preliminary surfacing.

b. Final alignment:

i. The track shall be given a final aligning conforming to the established track centers.

c. Final dressing:

i. After the final alignment the ballast shall be dressed to the section indicated. A 2 IN layer of local Coral crushed rock shall be applied to open track after final surfacing as indicated on the Contract Drawings. Source of Coral crushed rock will be given by HRS. After final dressing, ballast (and rock) shall not cover the tops of the ties. Coral rock shall not be used within the area of the crossing panels. The portion of the subgrade outside the ballast line shall be left with a full, even surface and the shoulder of the subgrade shall be properly dressed to the indicated section to provide proper drainage away from the track.

d. Surplus ballast:

i. Surplus ballast remaining after final surfacing and dressing of the ballast section shall be distributed or otherwise disposed of as directed by the Engineer.

(l) Tolerances for Finished Track:

1. Completed track shall meet the following tolerances.

a. Track not meeting the tolerances specified below shall be repaired to meet these requirements, at no additional cost to the Owner.

2. Gage:

a. Track gage shall be within plus 1/4 IN or minus 1/8 IN of 3 FT 0 IN narrow gage.

3. Alignment:

a. Alignment shall be measured as the deviation of the mid-offset of a 62 FT line, with the ends of the line at points on the gage side of the line rail, 5/8 IN below the top of the railhead.

i. Either rail may be used as the line rail on tangent track; however, the same rail shall be used for the entire length of the tangent.

ii. Alignment on tangents shall not deviate from uniformity more than 1/4 IN.

4. Track surface:

a. Track surface shall meet the following requirements:

i. The runoff at the end of a raise shall not exceed 1/2 IN in any 31 FT of rail.

ii. The deviation from design profile on either rail at the mid-ordinate of a 62 FT chord shall not exceed 1/2 IN.

iii. Deviation from zero cross level at any point shall not exceed 1/8 IN.

iv. The difference in cross level between any two points less than 62 FT apart shall not exceed 1/4 IN.

(m) Insulated Joint:

1. Insulated joints shall be installed where indicated and in accordance with the manufacturer's installation instructions.

(D) Laying Continuous Welded Rail (CWR)

(1) General:

(a) Handle CWR in a place and in a manner that prevents damage to the ties, rails and structures.

(b) Weld stagger shall be a minimum of 5 FT.

(c) Rail anchors shall be applied in accordance with track construction.

1. Anchor every tie within 90 ARA-A rail.

2. Do not anchor 90 ARA-A rail where 60 ASCE rail is opposite.

3. Temperature of a rail, when being laid opposite a previously anchored rail, shall be within -15 DegC (5 DegF) of the previously anchored rail's temperature at the time of its anchoring.

(2) Field Welding:

(a) Join 90 ARA-A lengths of rail in the field by the field welding (Thermite) process.

1. Perform field welds in accordance with the requirements of thermite welding procedures.

(b) Weld gap:

1. At the time of field welding, ensure that the rail is within the acceptable thermal stress temperature range and establish the rail gap recommended by the manufacturer of the weld kit.

(E) Existing Track

(1) Surfacing, lining and dressing: Surfacing, lining and dressing of existing track shall be done in accordance with Part 3.3 TRACK CONSTRUCTION above.

(2) Rail Joints:

(a) Within the limits of existing track to be surfaced and lined, the Contractor shall tighten all track bolts.

1. Defective track bolts, nuts and lock washers ("bolt assemblies"), and those that cannot be tightened shall be replaced.

(b) Damaged or unusable bolt assemblies:

1. Damaged or unusable bolt assemblies removed from rail joints shall become the Contractor's property and shall not be reincorporated in the work.

(3) Spot Tie Replacement:

(a) The Contractor shall replace defective ties as marked in the field and as directed by the Engineer.

(b) Paint markings and tie inspection:

1. Paint markings may exist on the existing rails and crossties.

2. Such markings do not necessarily indicate work within the scope of the contract.

3. The Contractor shall participate in a walk-through tie inspection with the Engineer prior to commencement of tie replacement work.

4. The scope of the tie replacement work will be determined at that time and relevant paint markings made or touched up as required.

(c) Additional tie work:

1. New ties shall be inserted in track with the heartwood down, square to the line of the rails.

a. Ties shall be inserted so that the average tie spacing in any one rail length does not exceed 21 IN and so that the maximum spacing between any two ties does not exceed 24 IN and the maximum spacing is not less than 18 IN.

b. Crosstie position at joints shall result in a "suspended joint" arrangement unless otherwise directed by the Engineer.

(d) Positioning of tie plates:

(a) Tie plates shall be positioned on the tie so that the shoulder has full bearing against the base of the rail.

(b) The plate shall be centered on the tie width, except that the plate shall be positioned up to 1/2 IN off-center if necessary to avoid spiking into an existing tie split.

(c) The Contractor shall ensure that all tie plates in a given stretch of track are either canted or flat.

(d) Canted and flat tie plates shall not be mixed within a given stretch of track.

(e) Re-spacing of existing ties:

1. Re-spacing of ties is required to straighten slewed ties or to correct uneven tie spacing.

2. Crib and shoulder ballast shall be removed as required to facilitate sliding crossties to their final position or to insert new ties.

3. Spike mauls or sledges shall not be used to slide ties.

4. Rail anchors and ballast shall be installed immediately after ties are re-spaced.

(f) Track gage:

1. Track gage shall be set at the time of spiking in accordance with Paragraph “Regaging.”

(F) Road Crossing

(1) Grade crossings within the Project shall be constructed as indicated on the Contract Drawings.

(2) Subgrade:

(a) The limits of new track construction are shown in the Contract Drawings.

(b) Drainage areas shall be cleaned and sloped away from the crossing in both directions along the track and the roadway.

(c) Subdrains shall be installed as indicated.

(3) Geotextile Installation:

(a) Geotextile shall be placed between the subgrade and the ballast (or subballast) section in the crossing area (as indicated in the drawings) and for 20 FT beyond each end of the crossing panels.

(b) Preparation:

1. Surfaces on which geotextiles will be placed shall be prepared in accordance with the applicable portions of this specification and shall be free of

irregularities such as sags, cavings, erosion, or vegetation.

2. Any irregularities shall be corrected to ensure continuous, intimate contact of the geotextile with the whole surface.

3. Any loose material or debris shall be removed prior to geotextile placement.

(c) Placement:

1. A protective subballast layer 6 IN thick shall be placed on top of the geotextile after it has been installed.

2. The geotextile shall be carefully placed on the prepared surface with the long dimension parallel to the prepared surface.

a. The geotextile shall be placed free of wrinkles, folds, creases, and tension.

b. The geotextile shall be covered immediately after placement in track (maximum exposure time shall be 2 consecutive days.)

3. The minimum overlap of geotextile splicing seams shall be 36 IN.

4. The geotextile shall remain free of any contamination such as mud, dust, sediment, debris, etc., that will impair its function.

a. Surface drainage, as much as possible, shall be directed away from the geotextile installation area to prevent accumulation of mud, debris, and sediment.

(d) Placement of cover material:

1. Placement of subballast cover material in contact with the geotextile shall be performed without damage to the geotextile including tears, punctures, or abrasion.

2. The minimum depth of ballast between the bottom of the tie and the top of the geotextile shall be 12 IN.

(e) Equipment operations on the cover material:

1. A minimum depth of 6 IN of cover material shall be placed over the geotextile before equipment is allowed to operate on the covered geotextile.

2. Equipment operations on the covered geotextile shall be limited to those necessary for track construction and equipment turning will not be allowed on the covered geotextile.

(f) Double layers:

1. Double layers of geotextile will not be allowed, except for splicing overlaps at seams.

(4) Placement of cover material:

(a) Placement of subballast cover material in contact with the geotextile shall be performed without damage to the geotextile including tears, punctures, or abrasion.

(b) The minimum depth of ballast between the bottom of the tie and the top of the geotextile shall be 12 IN.

(5) Equipment operations on the cover material:

(a) A minimum depth of 6 IN of cover material shall be placed over the geotextile before equipment is allowed to operate on the covered geotextile.

(b) Equipment operations on the covered geotextile shall be limited to those necessary for track construction and equipment turning will not be allowed on the covered geotextile.

(6) Double layers:

(a) Double layers of geotextile will not be allowed, except for splicing overlaps at seams.

(7) Ballast Placement and Surfacing:

(a) Ballast shall be placed and tamped as specified in Part 3.3 “Track Construction” except that in crossings, the ballast between the ties shall be thoroughly compacted with a vibratory compactor, or other approved means, after each raise.

(b) The ballast shall be tamped for the entire length of the crossties for road crossings.

(c) In addition to tamping, the ballast in the cribs and on the shoulders shall be compacted using a vibratory plate compactor or other approved means.

(8) Ties:

(a) Hardwood ties shall be used.

(b) For premanufactured grade crossings, ties shall conform to the manufacturer's recommendations.

(9) Tie Plates, Spikes, and Anchors:

(a) All ties within the crossing and having 90 ARA-A rail shall be fully tie plated, and spiked with 4 rail-holding spikes per tie plate.

(b) Each tie within the crossing and all ties with 90 ARA-A rail on each side shall be fully box anchored.

(10) Rail:

(a) Rail within the crossing area and beyond each end of the crossing as shown in the Contract Drawings shall be 90 ARA-A Section.

(b) Rail to be field welded shall be cropped to eliminate bolt holes except on the ends where compromise joints are to be installed.

(11) Lining and Surfacing:

(a) The track shall receive final alignment and surfacing prior to placement of the crossing surface.

(b) Rail shall be spiked to line and the track mechanically tamped and surfaced to the final grade and alignment as indicated on the Contract Drawings.

(c) The surface of the road shall be in the same plane as the top of the rails for a distance of 2 FT outside of the rails for either single or multiple-track crossings.

(d) A smooth transition shall be made between the crossing surface and the adjoining pavement.

(12) Crossing Surface:

(a) Prefabricated Concrete Panel Crossings:

1. Crossings and crossing materials shall be installed in accordance with the crossing manufacturer's instructions.

2. Tie spacings and track materials used in the crossing shall be in accordance with the installation instructions and manufacturer's recommendations.

(13) Signals:

(a) The type and location of railroad-road crossing warning devices are shown in the Contract Drawings and as specified in Section 34 42 00.00, Railway Signaling and Control Equipment.

(G) Bonding Track

(1) Track shall be bonded as indicated.

(a) Where track is designated for bonding, the rails shall be bonded electrically continuous.

(b) Connections shall be made by exothermite welds in accordance with the manufacturer's instructions.

(2) Rail Joint Bond:

(a) Rail joints on both rails of designated track shall be bonded using an exothermic type bond.

(b) The bond shall be applied to the field side of the rail head unless otherwise approved by the Engineer.

(c) Track to be bonded shall be electrically insulated from the remaining track using one of the specified insulated joints.

(H) Thermite Welding Procedures

(1) Thermite welding shall be done in accordance with AREMA Manual, Chapter 4, Part 2, Section 2.5 "Thermite Welding - Rail Joints" and Section 2.2 "Specification for Fabrication of Continuous Welded Rail," except as modified by these Specifications.

(2) Thermite welding procedures shall be performed by a technician certified to meet ANSI CP-189, level II or III qualifications and comply with the following paragraphs:

(3) End Preparation:

(a) Rails to be welded shall meet the requirements Section 2.2, "Specifications for Fabrication of Continuous Welded Rail" given in AREMA Manual, Chapter 4, Part 2.

1. The rail ends shall be aligned in accordance with Paragraph "Gap and Alignment."

2. Rail ends shall show no steel defects, dents, or porosity before welding.

3. Bolt holes shall not be made in, or permitted to remain in, the ends of the rail to be welded.

4. One handling hole may be made in each end of welded string.

5. Rail ends containing such holes shall be cut off during track construction.

6. Rail which must be cut for cropping or any other reason shall be cut square and clean by means of approved rail saws or abrasive cutting wheels in accordance with AREMA Manual, Chapter 5, Section 10.3, “Recommended Practice For Use of Abrasive Wheels.”

(b) Cleaning:

1. The rails to be welded shall be cleaned of grease, oil, dirt, loose scale, and moisture to a minimum of 6 IN back from the rail ends, including the railhead surface.

2. Cleaning shall be accomplished by use of a wire brush, to completely remove dirt and loose oxide and by use of oxygen-acetylene torch to remove grease, oil and moisture.

3. A power grinder with an abrasive wheel shall be used to remove scale rust, burrs, lipped metal and mill brands which would interfere with the fit of the mold, for 2 IN on each side of the ends.

(c) Gap and alignment:

1. The minimum and maximum spacing between rail ends shall be as specified by the rail welding kit manufacturer and the approved welding procedures.

a. Alignment of rail shall be done on the head of the rail. The rail gap and alignment shall be held without change during the complete welding cycle.

b. Vertical alignment shall provide for a flat running surface. Any difference of height of the rails shall be in the base.

c. Horizontal alignment shall be done so that any difference in the width of heads of rails shall occur on the field side.

i. Horizontal offsets shall not exceed 0.04 IN. in the head and/or 0.12 IN in the base.

(4) Surface Misalignment Tolerance:

(a) Combined vertical offset and crown camber shall not exceed 0.04 IN/FT at 600 DegF or less.

(b) Combined vertical offset and dip camber shall not exceed 0.01 IN/FT at 600 DegF or less.

(5) Gage Misalignment Tolerance:

(a) Combined horizontal offset and horizontal kink camber shall not exceed 0.04 IN/FT at 600 DegF or less.

(6) Thermite Weld Preheating:

(a) The rail ends shall be preheated prior to welding to a sufficient temperature and for sufficient time as indicated in the approved welding procedures to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

(7) Thermite Weld Cooling:

(a) The molds shall be left in place after tapping for sufficient time to permit complete solidification of the molten metal and proper slow cooling to prevent cracking and provide a complete weld with proper hardness and ductility.

(8) Weld Finishing and Tolerances:

(a) Welded joints in the finished track shall be brought to a true surface and alignment by means of a proper grinding or planing machine (shear).

(b) Finish grinding shall be performed with an approved grinder operated by a skilled workman grinding evenly and leaving the joints in a smooth and satisfactory condition.

(c) Finishing shall eliminate all cracks.

(d) The completed weld shall be finished by mechanically controlled grinding in conformance with the following requirements:

1. A finishing deviation of not more than plus or minus 0.01 IN of the parent section of the rail head surface will be allowed.

2. The gage side of the rail head shall be finished to plus or minus 0.01 IN of the parent section.

3. Welds produced by welding kits which are specially designed to produce reinforced welds need

not be ground in the finishing area except as necessary to remove fins, burrs, cracks, etc.

(9) Weld Quality:

(a) Each completed weld shall have full penetration and complete fusion and be entirely free of cracks or fissures. Welds shall meet the acceptance criteria given in AWS D1.1.

(10) Weld Numbering:

(a) The Contractor shall semi-permanently mark a sequential weld number on the rail immediately adjacent to the weld, using a quality lead paint marker at the time the weld is made.

(b) Welds shall be numbered sequentially in the order in which they are made.

(c) The Engineer will provide the Contractor with the initial weld number.

(d) Defective welds which are replaced shall be assigned a new sequential number by adding a letter to the defective weld number (e.g., defective weld 347 would be replaced by 347A).

(l) Sampling, Inspection and Testing

(1) Sampling, inspection and testing shall be the responsibility of the Contractor.

(a) Sampling and testing shall be performed by an approved commercial testing laboratory, , subject to approval.

(2) Ballast {and Subballast} Samples:

(a) Periodic sampling and testing of ballast {and subballast} material shall be performed to ensure continued compliance with this specification.

(b) During construction, one representative sample of the ballast {and subballast} material shall be taken from each 2,000 tons of ballast {and subballast} delivered to determine the material gradation.

(c) For each 10,000 tons or a fraction thereof of ballast delivered, an additional amount of material shall be obtained in order to perform the quality and soundness tests specified.

(d) Samples for material gradation, quality, and soundness tests shall be taken in conformance with ASTM D75.

(e) Test samples shall be reduced from field samples in conformance with ASTM C702.

(f) If any individual sample fails to meet the gradation quality and soundness requirements, placement shall be halted and immediate corrective action shall be taken to restore the specified gradation.

(3) Ballast {and Subballast} Tests:

(a) Sieve analyses:

1. Sieve analyses shall be made in conformance with ASTM C117 and ASTM C136.

2. Sieves shall conform to ASTM E11.

(b) Bulk specific gravity and absorption:

1. Bulk specific gravity and absorption tests shall be made in conformance with ASTM C127.

(c) Percentage of clay lumps and friable particles:

1. The percentage of clay lumps and friable particles shall be determined in conformance with ASTM C142.

(d) Degradation resistance:

1. Resistance to degradation of materials shall be determined in conformance with ASTM C131 and ASTM C535.

2. Materials with gradations having 100 percent passing the 1 IN sieve, shall be tested in conformance with ASTM C131.

3. Materials having gradations with particles larger than 1 IN shall be tested in conformance with ASTM C535.

(e) Soundness test:

1. Soundness tests shall be made in conformance with ASTM C88.

(f) Percentage of flat or elongated particles:

1. The percentage of flat or elongated particles shall be determined in conformance with ASTM D4791.

(4) Tie Inspection:

(a) The Contractor shall be responsible for the quality of the treated ties.

(b) Each tie shall be permanently marked or branded by the producer in accordance with AWPA M6.

(c) Each treated wood tie shall be inspected, in accordance with AWPA M2, for conformance with the specified AWPA standards.

(d) The 100 percent inspection shall be performed by an independent inspection agency approved by the Engineer.

(e) Inspection shall be made at the wood treatment site.

(f) The agency's report of inspection shall accompany delivery of the ties.

(5) Examination of Geotextile:

(a) The Engineer may examine any geotextiles for defects, damage, or nonconformance prior to installation.

(b) Any geotextile not meeting the minimum property requirements of Paragraph "Geotextile," or geotextile that is determined to be damaged or defective shall be removed from the site and shall be replaced with additional geotextile meeting the requirements of this specification at no additional cost to the Owner.

(6) Examination of Geogrid:

(a) The Engineer may examine any geogrid for defects, damage, or nonconformance prior to installation.

(b) Any geogrid not meeting the minimum property requirements of Paragraph "Geogrid," or geotextile that is determined to be damaged or defective shall be removed from the site and shall be replaced with additional geogrid meeting the requirements of this specification at no additional cost to the Owner.

(7) Track:

(a) Inspection shall be performed to ensure that all the requirements of these specifications are met.

(b) Bolted joints shall be inspected for loose bolts and for smooth transitions between rails of different sections.

(c) Rail, tie plates, and ties shall be checked to ensure that the rail is properly seated and has full bearing on the tie plate and tie.

(d) Upon completion of construction, measurements of track gage, cross level, and alignment shall be taken and recorded at least once every 25 FT of track centerline length.

(e) A copy of these measurements shall be provided to the Engineer.

(8) Thermite Weld Joints Inspection and Testing:

(a) Quality control inspection and field testing shall be performed by a technician certified to meet ANSI CP-189 level II or III qualifications with a minimum of one year experience in testing rail for defects.

1. The Contractor shall pay particular attention to surface cracking, slag inclusion, gas pockets, and lack of fusion.

2. The Contractor shall correct or replace, at no extra cost to the Owner, any weld found defective.

3. The method of correction shall be as approved by the Engineer.

(b) Each thermite weld joint shall be ultrasonically tested following the visual inspection.

1. The method of inspection and acceptance shall be in accordance with AWS D1.1.

2. The method of correction shall be as approved by the Engineer.

3. Welds made in the track which the Engineer determines to be unacceptable shall be cut out of the rail and replaced by a section of replacement rail and two new welds.

4. Replacement welds and replacement rails shall be at the sole expense of the Contractor.

5. Replacement welds shall be renumbered as indicated.

6. Replacement welds made in track shall be ultrasonically tested.

(9) Testing Relay Rail:

(a) Testing for wear:

1. Each relay rail shall be checked for wear by the Contractor's quality control representative in the presence of the Engineer after the material is delivered to the construction site.

2. The Contractor shall monitor the installation of track for defects in rail and joint bars being installed.

3. Rail and joint bars that are found to be defective shall not be installed in track.

(b) Testing for defects:

1. Ultrasonic testing shall be done by a Contractor normally engaged in this type of testing with a minimum of 5 years of experience.

2. Contractor furnished rails which are found to have any detectable defect at any time during construction shall be removed and replaced by the Contractor at no additional cost to the Owner.

3. Contractor furnished joint bars and compromise joint bars that are found to be cracked or broken shall be removed and replaced at no additional cost to the Owner.

RECORD OF FIELD WELD

INSTALLATION: _____ WELD NUMBER: _____

FINAL INSTALLED
LOCATION: _____ TRACK: _____
STATION: _____ RAIL: Left Right (Circle)

DATE: _____ TIME: _____AM / PM (Circle)

AIR TEMPERATURE: _____ F* WEATHER: _____
RAIL TEMPERATURE: _____ F* _____

WELD KIT MANUFACTURER: _____
RAIL GAP
NEAREST 1/16 IN: _____
RAIL CUT REQUIRED? YES NO (Circle)
BACK RAIL
MANUFACTURER: _____ USED RAIL? YES NO (Circle)
YEAR/MONTH ROLLED: _____ HEAT NUMBER: _____
_____
AHEAD RAIL
MANUFACTURER: _____ USED RAIL? YES NO (Circle)
YEAR/MONTH ROLLED: _____ HEAT NUMBER: _____
_____

REMARKS: _____
_____
_____

ULTRASONIC TEST DATE AND RESULTS: _____
_____

KIT MANUFACTURER REPRESENTATIVE
PRESENT: _____ WELDING FOREMAN: _____
(Initial) (Signed)

ENGINEER'S REPRESENTATIVE
PRESENT: _____ RECORDER: _____
(Initial) (Signed)
PRESENT: _____ RECORDER: _____
(Initial) (Signed)

FOR OWNER USE ONLY:
ULTRASONIC TEST DATE AND RESULTS: _____
_____

* Note: Determination will be made to the nearest 1/2 degree.

661.04 Measurement. Railroad track construction will be paid on a lump sum basis. Measurement for payment will not apply.

661.05 Payment. The Engineer will pay for the accepted railroad track construction on a contract lump sum basis. Payment will be full compensation for the work prescribed in this section and the contract documents.

The Engineer will pay for the following pay items when included in the proposal schedule:

Pay Item	Pay Unit
Railroad Track Construction	Lump Sum

The Engineer will pay for the accepted hauling and stockpiling of salvaged materials and equipment off the right-or-way, as order by the Engineer, in accordance with Subsection 104.02-Changes."

END OF SECTION 661

Make the following Section a part of the Standard Specifications:

SECTION 695 – PORTABLE CONCRETE BARRIER, INERTIAL BARRIER SYSTEM AND LANE-SHIFT PAVEMENT MARKINGS

695.01 Description. This section is for furnishing, hauling, installing, maintaining, relocating, and subsequently removing new and State-furnished portable concrete barriers, inertial barrier systems, and lane-shift pavement markings according to the contract documents.

695.02 Materials.

(A) Portable Concrete Barriers. Materials shall meet the requirements specified in the following subsections of Division 700 - Materials.

Reinforcing Steel	709.01
Structural Steel	713.01
Standard Fasteners	718.01
Reflector Marker	750.07
Preformed Pavement Marking Tape	755.04

(B) Inertial Barrier System (Sand Barrels).

(1) Container. The inertial barrier system shall consist of modules in 200, 400, 700, 1400, and 2100 lbs. sizes. 200, 400, 700 and 1400 lbs. modules shall consist of a container molded in one piece with a minimum capacity of 21 cubic feet. The material shall be durable, weatherproof, and shall be formulated to resist deterioration from ultraviolet rays. The color shall be yellow.

This model must be of continuous molded construction and be nestable. The modules shall be designed and manufactured from a frangible polyethylene material which shall shatter upon impact to permit dispersion of the sand mass container within.

(2) Lid. Each module shall have a black lid which locks securely over the top lip of the outer container. Material shall be durable, weatherproof, and shall be formulated to resist deterioration from ultraviolet rays.

(3) Insert. All 200, 400 and 700 lbs. modules will require a cone-shaped supporting insert used to support various sand masses. Cone inserts shall be of one-piece molded construction and be nestable.

(4) Sand. Sand placed into these modules should be washed concrete sand conforming to ASTM-C-33 or equal.

The center of gravity of each properly filled module shall be at a height which will aid in controlling the pitch of standard passenger vehicles.

The components of the modules shall interface to prevent leakage of sand contained therein. The interface shall, however, permit drainage of excess water contained within the sand mass.

(5) Test Level. The inertial barrier system shall be a non-redirective, energy-absorbing terminal. For design speeds up to 43 mph it shall meet NCHRP-350, Test Level 2 criteria for Non-Redirective Crash Cushions, as accepted by the Federal Highways Administration (FHWA).

Inertial barrier system for design speeds above 43 mph (up to 62 mph) shall meet NCHRP-350, Test Level 3 criteria for Non-Redirective Crash Cushions, as accepted by FHWA.

Each inertial barrier system array shall be configured per manufacturer's recommendations, and complies with appropriate NCHRP-350 Test Level criteria as indicated in the contract documents or as directed by the Engineer.

695.03 Construction.

(A) Portable Concrete Barriers.

(1) Fabrication. Construct new portable concrete barriers in accordance with contract plans and as modified herein. The barriers shall be in 20-foot segments. Prior to fabrication of the new portable concrete barrier, submit detailed shop drawings to the Engineer for acceptance.

(a) Forms. Forms shall be according to Section 503 - Concrete Structures.

(b) Placing Concrete. Moisten the form thoroughly immediately prior to the placing of the concrete. Place the concrete in accordance with Section 503 - Concrete Structures.

(c) Curing. Steam or water-cure the portable concrete barriers in accordance with Subsection 504.03(G) - Curing.

(d) Handling. Do not handle the newly casted portable concrete barriers until the concrete has attained a compressive strength of more than 3,000 pounds per square

inch. Use the lifting holes to hoist the portable concrete barrier. Repair or replace units damaged by improper handling at no increase in contract price and contract time.

The Engineer will permit stacking of precast units with prior acceptance by the Engineer of the method to be employed by the Contractor.

(2) Ownership. The newly constructed portable concrete barriers shall become the property of the State after project completion.

(3) State-Furnished Portable Concrete Barrier. Select the barrier units from the State stockpile at storage location shown in the contract documents or as specified by the Engineer. Haul the barrier units from the storage areas to the job site.

(4) Accessories. Furnish, install, and maintain steel pins for connecting the barrier units.

Furnish, and install one (1) RM-2 reflector marker, and a steady burn amber lamp on top of each 20-foot concrete barrier unit.

Furnish, and install longitudinal 4-inch by 20 feet permanent preformed pavement marking tape, Type I (color to match adjacent roadway pavement stripe) on the sloped side of the barrier unit facing traffic.

(5) Type II Barricades. Furnish, and install Type II Barricades with a steady burn amber lamp. Spacing and position shall comply with part 6 of the MUTCD Typical Application 5.

(6) Installation. Erect all barrier units as shown on the plans or as directed by the Engineer. Grade and compact the ground prior to placing the units. Set the units in a vertical position, closely following the roadway grade. The units shall have a maximum of 1/4-inch offset in any direction between adjacent panels at the connections.

Horizontal alignment of the panels shall be such that any panel is not out of alignment by more than 1/2-inch from straight line. Furnish and install steel pins for connecting the barrier sections according to contract documents.

Relocate any units or existing barriers during construction at the locations shown in the contract documents or as directed by the Engineer at no increase in contract price and contract time.

(a) End Treatments. Contractor shall shield barrier ends exposed to traffic with end treatments that comply with

appropriate NCHRP-350 Test Level criteria as indicated in the contract documents or as directed by the Engineer. Do not mix existing State portable concrete barrier of older NCHRP-230 design, if available, with newer NCHRP-350 compliant units within the same barrier installation.

(b) Cleaning and Repair. Upon completion of the work, remove, clean, and repair all barrier units. The cleaning and repair of the units shall be performed regardless of cause, such as 'wear and tear' or improper handling by the Contractor during use. Repair all damaged unit back to its original configuration.

A damaged barrier unit that, in the judgment of the Engineer, is considered irreparable shall be replaced with a new unit furnished by the Contractor at no increase in contract price or contract time.

All portable concrete barrier units will be inspected by the Engineer before the Contractor delivering them to the storage area.

(c) Hauling and Storage. Remove, haul, and store all barrier units at the storage location shown in the contract documents or as directed by the Engineer. If the final destination is not available when the units are ready to be removed, haul the units to an interim location at no increase in contract price or contract time.

(B) Inertial Barrier System (Sand Barrels).

(1) Installation. Furnish, install, and maintain the inertial barrier system in accordance with the manufacturer's recommendations. Grade and compact the ground prior to placing modules. Filling each installed inertial barrier module with sand.

(a) Cleaning and Repair. Upon completion of the work, remove, clean all inertial barrier modules. Remove and dispose of sand from installed inertial barrier modules.

All inertial barrier modules will be inspected by the Engineer before the Contractor delivering them to the storage area.

(b) Hauling and Storage. Remove, haul, and store all empty modules at the storage location shown in the contract documents or as directed by the Engineer. If the final destination is not available when the units are ready to be removed, haul the units to an interim location at no increase in contract price or contract time.

(2) Ownership. The inertial barrier system (sand barrels) shall become the property of the State after project completion.

(C) Pavement Striping and Markers for Lane Shifting.

Furnish, and install pavement striping and markers according to Section 629 - Pavement Markings, Subsection 629.03 (C). Do not use temporary pavement striping and markers. Striping shall be done in accordance with the contract documents or as directed by the Engineer.

If no striping plan is provided, submit striping plan for approval 14 days prior to the setting of the units.

Upon completion of the contract work, remove the lane shift striping and markers, and restore original striping and markers in accordance with the contract documents or as directed by the Engineer.

695.04 Measurement. The Engineer will measure State-furnished portable concrete barrier per each.

The Engineer will not measure the inertial barrier system for payment.

The Engineer will not measure installing, maintaining, and subsequently removing lane shift pavement striping and markers for payment.

695.05 Payment. The Engineer will pay for the accepted State-furnished portable concrete barriers at the contract unit price per each. The price includes full compensation for work prescribed in this section and the contract documents.

The Engineer will not pay separately for installing, maintaining, relocating, and subsequently removing the portable concrete barriers. The price includes full compensation for preparing beds; hauling and setting portable concrete barriers; installing connector pins; maintaining reflector markers, lamps, and permanent preformed pavement marking tape; relocating portable concrete barriers during construction; cleaning, repairing and hauling the portable concrete barriers after completion of the project to locations on the island of Oahu as directed by the Engineer; and furnishing labor, materials, tools, equipment and incidentals necessary to complete the work.

The Engineer will pay for the accepted inertial barrier system at the contract lump sum price complete in place. The price includes full compensation for work prescribed in this section and the contract documents.

The Engineer will not pay separately for installing, maintaining, relocating,

and subsequently removing the inertial barrier system. The price includes full compensation for submitting a list of materials and equipment to be incorporated in the work; grading and compacting the ground; furnishing, assembling, and installing an inertial barrier system; relocating inertial barrier system to locations specified in the contract; filling each installed inertial barrier module with sand; removal and disposal of sand; cleaning and hauling the empty modules to locations on island of Oahu as directed by the engineer upon completion of the project, and furnishing labor, materials, tools, equipment and incidentals necessary to complete the work.

The Engineer will consider the cost for the lane shift pavement striping and markers included in the contract price for portable concrete barrier.

The Engineer will not pay separately the pavement striping and markers for lane shifting. The price includes full compensation for submitting the striping plans; removing the existing pavement striping and markers; installing the lane shift pavement striping and markers; removing the lane shift striping and markers; and restore original striping and markers according to the contract or as directed by the Engineer; and furnishing labor, materials, tools, equipment and incidentals necessary to complete the work.

The Engineer will pay for each of the following pay items when included in the proposal schedule:

Pay Item	**Pay Unit**
State-Furnished Portable Concrete Barrier	Each
Inertial Barrier System	Lump Sum

The Engineer will make partial payments as follows:

(1) Pay 40% of the amount bid when the barrier are furnished and delivered to the jobsite and prepared the ground for installation.

(2) Pay 40% of the amount bid when the barrier are assembled and installed, relocated and maintained during construction, and replaced damaged barriers.

(3) Pay the remainder of the contract amount upon removal and delivery of the barriers and modules after completion of the project or as directed by the Engineer."

END OF SECTION 695

Make this section a part of the Standard Specifications:

"SECTION 761 – LIGHT EMITTING DIODE (LED) PATHWAY LIGHTING SYSTEMS MATERIALS

761.01 Light Poles. Light poles shall be made of aluminum, conforming to requirements of AASHTO publication *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, and this subsection. Drawings for proposed poles shall be submitted in accordance with Subsection 621.03(A) - Equipment List and Drawings.

(A) Aluminum Poles. Aluminum poles shall be spun tapered from seamless aluminum tubing, alloy 6063-T6, conforming to ASTM B 221, with minimum thickness of 0.125 inch. Circumferential or longitudinal welds will be allowed only at lower end of pole where pole is joined to anchor base.

Poles shall have anchor base consisting of permanent mold cast aluminum, alloy 356.0, conforming to ASTM B 108. Anchor bolts shall be stainless steel conforming to Subsection 718.01 - Standard Fasteners, and shall be of quantity and grade indicated in the contract documents.

Pole shall have cast aluminum (alloy 356-T6) decorative, pedestal breakaway base with door and vandal resistant stainless steel screws. Ground lug shall be provided inside the base, opposite the door. The base shall be FHWA accepted.

Each pole shall be furnished complete with base, base cover, and anchor bolts. Unless otherwise indicated in the contract documents, aluminum poles shall have dark bronze powder coat over clear anodized finish.

Aluminum poles shall be protected during shipment with protective paper.

761.02 Luminaires for Pathway Lighting. Luminaires shall conform to the provisions in Section 761.03, "Luminaires for Pathway Lighting", of Section 761 Light Emitting Diode (LED) Pathway Lighting Systems Materials.

Luminaires shall conform to the following Standards and Special Provisions:

<u>Standards</u>

- ANSI/NFPA 70, National Electrical Code

- FCC 47 CFR Part 15, Federal Code Of Regulation (CFR) testing standard for electronic equipment
- IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- IESNA TM-15, Luminaire Classification System for Outdoor Luminaires
- NEMA SSL 3-2010, High-Power White LED Binning for General Illumination
- UL1598, Standard for Safety of Luminaires

(A) Luminaires for Pathway Lighting. Luminaires for pathway lighting shall be nominal 4000K Light Emitting Diode (LED) type, suitable for wet locations per UL 1598. Luminaire shall produce zero light at or above 90 degrees. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires in wet locations, IP66 certified, and RoHS compliant.

1. Housing. Housing shall conform to the following:

a) One-piece die-cast, low copper (<0.6% Cu) Aluminum Alloy with internal cooling fins.

b) One-piece flat glass lens with silicon gasket.

c) Fade and abrasion resistant, electrostatically applied, thermally cured, triglycidal isocyanurate (TGIC) polyester powder coat over clear anodized finish.

d) Dark bronze smooth color.

e) Backlight control on each LED module to completely control unwanted backlight.

f) One-piece low copper aluminum alloy, die-cast lens frame.

g) Dimming range from 100% to 10% through the use of the standard 0-10V interface.

2. Optics. The luminaire optics shall conform to the following:

a) LEDs shall be mounted to a meal printed circuit board assembly.

b) Optical lens shall be clear injection molded PMMA (polymethyl methacrylate) acrylic.

3. Electrical. The electrical features shall include:

a) Universal operating voltage, 120 through 277V with a + or – 10% tolerance.

b) Driver shall be Underwriters Laboratories recognized.

c) Standard programmable drive allows for programmable drive current settings.

d) Electrical components are strategically located in the driver gear compartment with a molded silicon grommet seal to provide separation from the optical chamber.

e) Maximum lightning surge current 20KA with thermally protected varistor technology. Surge suppression is series circuited preventing total fixture failure. ANSI/IEEE C2.41 Category C High.

f) Open circuit fault will turn off the luminaire in order to protect the sensitive electronics and acts as a signal for maintenance.

g) Programmable Driver is rated -40ºC starting.

h) “Thermal Shield”, primary side, thermistor provides protection for the sustainable life of electronic components.

4. Illumination. Luminaires shall provide pathway with minimum average maintained illumination and average to minimum uniformity as indicated in Section 621.03, “Construction Requirements” of Section 621 Pathway Lighting System.

a) Photometry must be compliant with IESNA LM-79.

b) Luminaire shall have a minimum efficacy of 58 lumens per watt and shall not consume power in the off state.

c) BUG rating shall not exceed U0.

d) Luminaire manufacturer shall provide the LED manufacturers LM-80 report.

5. Photoelectric Control Receptacle. Luminaires shall be furnished with photoelectric control receptacles, as indicated in the contract documents.

a) When a photo control receptacle is required, it shall be compliant with ANSI C136.41-2013, 7-pin photocontrol receptacle with twist lock photo control. This shall provide a standard method of light level control between external PCR and a dimmable driver for future use.

6. Warranty. Luminaires shall be warranted to be free from manufacturing defects for a period of 5 years.

a) LED luminaire manufacturer shall provide 5-year warranty on LED luminaires that includes LEDs, housing, drivers and finish.

b) Technical properties must be made available for a minimum of 5 years after the date of manufacture.

c) Luminaires shall be fully assembled and individually electrically tested prior to shipment.

7. Manufacturer. The luminaire manufacturer shall have a minimum of 15 years of experience in the manufacture, assembly, and sale of pathway luminaires in the United States of America. The pathway luminaire shall comply with the Buy America Act and the American Recovery and Reinvestment Act of 2009 (ARRA). The manufacturer shall have a minimum of 10,000 pathway luminaires installed within the United States of America prior to bid opening.

8. Submittals. Product data submitted for approvals shall

include, but not limited to materials, finishes, photometric performance, photometric layouts, dimensional information and LM-79 report for each luminaire.

9. Delivery, Storage and Handling. Deliver luminaires and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment. Store luminaires and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

761.03 Cables and Wires for Lighting and Power System

(A) Cables and Wires.

1. Circuit Cable. Cable for 120/240 volt or 240/480 volt circuits shall conform to the following requirements: single conductor, 600 volt, AWG sizes as indicated in the contract documents; stranded copper, Type XHHW suitable for use at 167 degrees F, with 2/32-inch-thick rubber insulation, and 3/64-inch thick neoprene jacket. Rubber insulation and neoprene jacket shall conform to NEC, RHW/USE standards, and ICEA S-105 692 standard.

2. Pole Fixture Cable. Connection of circuit cables from base of light pole or pull box to each luminaire shall conform to the following requirements: single conductor, 600 volt, No. 10 AWG, stranded copper, and Type XHHW or RHW. Unless otherwise indicated in the contract documents, ground conductors shall conform to the following requirements: single conductor, 600 volt, No. 6 AWG, stranded copper, Type XHHW or RHW. Ground conductors shall be installed in conduits.

(B) Luminaire and Cable and Wire Identification. Tags of rigid, non-ferrous material shall be affixed, with machine embossed legend on two sides with non-ferrous wire to feeder, branch feeders, and sub-branch cables and wires in pullboxes and light standard bases. Legend with 1/4-inch-high letters shall indicate feeder designation.

761.04 Disconnect and Protective Devices.

(A) General. Splices and taps shall be limited to minimum number. Conductor-to-conductor connections shall be made with hydraulically indented lugs.

(B) Taps. Taps from feeders to pathway lighting luminaires shall be made at

lighting standards, with standard connector kits that provide quick-disconnect, fused branch connection to feeder conductors. Waterproof taps shall have dielectric value equal to that of the insulation of conductors joined. Fuses shall be standard midget, ferrule-type, with ampere ratings an indicated in the contract documents.

(C) Splicing. Feeders shall be spliced with standard splicing kits of type recommended by cable manufacturer. Splices shall be waterproof and shall have dielectric value equal to that of the insulation of conductors joined.

761.05 Waterproof Connectors for Pathway Lighting. Where indicated in the contract documents, connector kits shall be of waterproof, molded rubber. Connectors shall be 600-volt, quick disconnect, in-line connectors, fused for ungrounded conductor and non-fused for neutral at each pole. Opening in line conductor connectors shall be suitable for cables furnished. Lubrication and taping shall be as recommended by manufacturer of connectors. Fused connectors shall accommodate standard midget, ferrule-type fuses with ampere rating as indicated in the contract documents.

761.06 Dimming Photoelectric Control. Photoelectric control unit shall be compatible with the ANSI C136.41 receptacle (on the luminaire head) and provide selectable dimming of the luminaire head. The unit shall have a load rating of 1,000W/1800 VA with a power consumption of less than 0.5 watts at 120 volts. Photoelectric control shall withstand surge current up to 40,000 amperes and have a dielectric strength of 5000 volts between current carrying parts. The unit shall be provided with three selectable dimming levels (30%, 50%, and 70%) and three selectable start times (10:00 PM, Midnight, or 2:00AM) which are settable through the ten-position selector switch located on the bottom of the base. Field adjust selector switch to dim all heads to 70% at Midnight. All dimming schedules will return to full brightness at 5:00 AM. The unit shall turn-on at 1.5 foot candles +/- .25 foot candles with 1.5:1 off/on ratio and 3 to 5 second turn-off delay.

FP Outdoor Lighting Controls DIM-4 or approved equivalent."

END OF SECTION 761

SECTION 770 – TRAFFIC SIGNAL MATERIALS

Make the following amendments to said Section:

(I) Amend **Subsection 770.02(A)(1)(b) – Traffic Signal Heads, Optical Units** by revising the first paragraph from line 211 to 216 to read:

"(b) To ensure quality and performance, LED head shall have prior history of testing and use by CALTRANS and shall exceed ITE standards. Failure on one LED shall not affect other LED's. LED head shall have fully-encapsulated electronic circuitry and configuration for 12-inch ball."

(II) Amend **Subsection 770.04 – Pedestrian Signal** from line 447 to 600 to read:

"(A) Purpose.

The purpose of this specification is to provide the minimum requirements for the LED "walking person" and "hand" icon pedestrian signal modules with countdown. This specification is only for the nominal overall message-bearing surface of 16 x 18 in. This specification is not intended to impose restrictions upon specific designs and materials that conform to the purpose and the intent of this specification. This specification refers to definitions and practices described in "Pedestrian Traffic Control Signal Indications" published in the *Equipment and Materials Standards of the Institute of Transportation Engineers*, (referred to in this document as "PTCSI") and in the Applicable Sections of Manual on Uniform Traffic Control Devices (MUTCD) 2003 Section 4E.

(B) Physical and Mechanical Requirements.

The modules shall fit into existing pedestrian signal housings built for the PTCSI sizes stated in Section 1 of the "walking person" and "hand" icon pedestrian signal indication Standard without modification to the housing and shall not require special tools for installation.

Installation of a retrofit replacement module into existing pedestrian signal housing shall only require the removal of the existing optical unit components, shall be weather tight and fit securely in the housing; and shall connect directly to existing electrical wiring. The LED module shall have a visual appearance similar to that of an incandescent lamp (ie: Smooth and non-pixilated). Screwed on lenses are not allowed. Only modules with internal mask shall be utilized. No external silk-screen shall be permitted.

When not illuminated, the WALKING PERSON, UPRAISED HAND, and COUNTDOWN DIGITS shall not be readily visible. The countdown digits of the pedestrian signal module shall be located to the right of the associated UPRAISED HAND. The display of the number of remaining seconds shall begin only at the beginning of the pedestrian change interval. After the countdown displays zero, the display shall remain dark until the beginning of the next countdown. The walking person, hand icons and countdown digits shall be incandescent looking.

The units shall not have any external attachments, dip switches, toggle switches or options that will allow the mode to be changed from counting the clearance cycle, to the full walk/don't walk cycle or any other modification to the icons or digits.

For each nominal module, use the corresponding minimum H (height) and W (width) measurements:

Module Size	Icon Height	Icon Width	Countdown Height	Countdown Width	Countdown Segment Width
(16 x 18 in)	11 in	7 in	9 in	7 in	0.7 in

All exposed components of a module shall be suitable for prolonged exposure to the environment. As a minimum, the module shall be rated for use in the ambient operating temperature range, measured at the exposed rear of the module, of -40°C to +74°C (-40°F to +165°F).

The module shall be a single, self-contained device, not requiring on-site assembly for installation into an existing pedestrian signal housing. The power supply shall be located inside the pedestrian signal module. The assembly and manufacturing process for the module shall be designed to assure all internal LED and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

The front window shall be a transparent polycarbonate material with internal masking to prevent the icons and digits from being visible when not in operation. External masking or silk-screen technology shall not be permitted.

Each module shall be identified on the backside with the manufacturer's name, model, serial number and operating characteristics. The operating characteristics shall include the

nominal operating voltage and stabilized power consumption, in watts and/or Volt-Amperes.

(C) Photometric Requirements

For a minimum period of 60 months, the maintained minimum luminance values for the modules under operating conditions, when measured normal to the plane of the icon surface, shall not be less than:

- Walking person: 2,200 cd/m^2;
- Hand: 1,400 cd/m^2.
- Countdown digits: 1,400 cd/m^2;

The luminance of the emitting surface, measured at angles from the normal of the surface, may decrease linearly to a value of 50% of the values listed above at an angle of 15 degrees. The LED module shall have a visual appearance similar to that of an incandescent lamp (ie: Smooth and non-pixilated).

Maximum permissible luminance: When operated within the temperature range, the actual luminance for a module shall not exceed three times the required peak value of the minimum maintained luminance. Luminance uniformity: The uniformity of the signal output across the emitting section of the module lens (i.e. the hand, person or countdown icon) shall not exceed a ratio of 5 to 1 between the maximum and minimum luminance values (cd/m^2).

The standard colors for the LED Pedestrian Signal Module shall be White for the walking person and Portland Orange for the hand icon and the countdown digits.

(D) Electrical Requirements

All wiring and terminal blocks shall meet the requirements of Section 13.02 of the VTCSH Standard. Maximum of three secured, color coded, 1 meter (39 in) long 600 V, 16 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at +105°C, are to be provided for electrical connection. The conductors shall be color coded with orange for the hand, blue for the walking person and white as the common lead.

LED modules shall operate from a 60 $\pm$ 3 Hertz ac line power over a voltage range from 80 to 135 VAC RMS. Nominal operating voltage for all measurements shall be 120 $\pm$ 3 VAC RMS. Fluctuations in line voltage over the range of 80 to 135 VAC RMS shall not affect luminous intensity by more than $\pm$ 10 %. To prevent the appearance of flicker, the module circuitry shall drive

the LEDs at frequencies greater than 100 Hz when modulated, or at DC, over the voltage range specified.

Low Voltage Turn Off: There should be no illumination of the module when the applied voltage is less than 35 VAC RMS. To test for this condition, each icon must first be fully illuminated at the nominal operating voltage. The applied voltage shall then be reduced to the point where there is no illumination. This point must be greater than 35 VAC RMS.

Turn-ON and Turn-OFF Time: A module shall reach 90% of full illumination (turn-ON) within 75 msec of the application of the nominal operating voltage. The signal shall cease emitting visible illumination (turn-OFF) within 75 msec of the removal of the nominal operating voltage.

Default Condition: For abnormal conditions when nominal voltage is applied to the unit across the two-phase wires (rather than being applied to the phase wire and the neutral wire) the pedestrian signal unit shall default to the hand symbol. The on-board circuitry of a module shall include voltage surge protection:

- To withstand high-repetition noise transients and low-repetition high-energy transients as specified in NEMA Standard TS-2 2003; Section 2.1.8
- Section 8.2 IEC 1000-4-5 & Section 6.1.2 ANSI/IEEE C62.41.2-2002, 3kV, 2 ohm
- Section 8.0 IEC 1000-4-12 & Section 6.1.1 ANSI/IEEE C62.41.2-2002, 6kV, 30 ohm

The LED signal and associated on-board circuitry shall meet the requirements of the Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise by Class A digital devices. The modules shall provide a power factor of 0.90 or greater when operated at nominal operating voltage, and 25ºC (77ºF). Total harmonic distortion induced into an AC power line by the module, operated at nominal operating voltage, and at 25ºC (77ºF) shall not exceed 20%.

The current draw shall be sufficient to ensure compatibility and proper triggering and operation of load current switches and conflict monitors in signal controller units. Off State Voltage Decay: When the module is switched from the On state to the Off state the terminal voltage shall decay to a value less than 10 VAC

RMS in less than 100 milliseconds when driven by a maximum allowed load switch leakage current of 10 milliamps peak (7.1 milliamps AC).

(E) Module Functions

The module shall operate in one mode: *Clearance Cycle Countdown Mode Only.* The module shall start counting when the flashing don't walk turns on and will countdown to "0" and turn off when the steady "Don't Walk" signal turns on. The m*odule shall not have user accessible switches or controls for the purpose of modifying the cycle, icons or digits.* At power on, the module enters a single automatic learning cycle. During the automatic learning cycle, the countdown display shall remain dark. The unit shall re-program itself if it detects any increase or decrease of Pedestrian Timing. The digits shall go blank once a change is detected and then take one complete pedestrian cycle (with no counter during this cycle) to adjust its buffer timer.

The module shall allow for consecutive cycles without displaying the steady Hand icon ("Don't Walk"). The module shall recognize preemption events and temporarily modify the crossing cycle accordingly. If the controller preempts during the walking man, the countdown shall follow the controller's directions and shall adjust from walking man to flashing hand. It shall start to count down during the flashing hand. If the controller preempts during the flashing hand, the countdown shall continue to count down without interruption. The next cycle, following the preemption event, shall use the correct, initially programmed values. This specification is worded such that the flashing don't walk time is not modified.

If the controller output displays Don't Walk steady condition or if both the hand /person go dark and the unit has not arrived to zero, the unit suspends any timing and the digits shall go dark.

(F) Warranty

Manufacturers will provide the following warranty provisions. Replacement or repair of an LED signal module that fails to function as intended due to workmanship or material defects within the first 5 years (60 months) from the date of delivery."

(III) Amend **Subsection 770.05(A)(2)- Controller Equipment, Controller Assembly** by replacing Table 770.05-1 – Controller Assembly Requirements with the following:

TABLE 770.05-1 – CONTROLLER ASSEMBLY REQUIREMENTS	
Item	Quantity
Model 170 Controller	1
Model 412C Prom Module	1
Model 400 Modem	1
332A Aluminum Cabinet	1
Model 200 Load Switches	12
Model 204 Flasher	All
Model 242 Isolators	2
Model FS/ST Isolator	All
Flash Transfer Relays	All
Model 210 Conflict Monitor (Crimp and Poke Type, such as Molex Dualcon TM Straight/on Edge Dual Position Connectors, or approved equal)	1
Model 262C Detector Amplifiers (Rotary Sw Type)	8
Model M752 Preempt. Car (Non-QPL)	2
Model GPS Time Source (Non-QPL)	1

(IV) Amend **Subsection 770.05(B)(6)- Controller Equipment, Model 170E Controller** by deleting line 643.

(V) Amend **Subsection 770.05(C)(5)- Controller Equipment, Cabinet** by deleting lines 660 to 665.

(VI) Amend **Subsection 770.05(D)(2) – Universal Time Standard (UTS) Module** line 712 to 741 to read:

(2) Security Tumbler for Signal Cabinet. The signal control cabinet door locks (2 locks for each cabinet) are keyed to take Best Lock Series tumblers. The contractor shall furnish and install 2 lock cylinders that will fit in the current locks on the signal cabinet. The lock cylinders keys shall be one of a kind, licensed to the City and County of Honolulu, and each cylinder shall have 1 set of keys with “do not duplicate” stamped on each key.

(3) GPS Time Source. The GPS time source unit shall be a precision Time Standard for use on 170 Traffic Signal Controllers. It utilizes time signals broadcast from the GPS satellite network and is traceable to the National Institute of Standards (NIST). The unit incorporates a precision GPS receiver and a microprocessor to decode the time signals and interface to the traffic control equipment.

The standard features of the GSP unit shall include, but not limited to, Time and date information includes Year, Month, Day, Hour, Minute, and Second, All functions are automatic, no jumpers or switches to set, Time zone, baud rate, and Daylight savings operation set with dumb terminal, User set parameters stored in non-volatile EEPROM, 24 hour backup for time keeping, Standard 3 wire RS232 interface, Automatic daylight savings and leap second time corrections, LED status indicator, operates on controller +5 Volts from communications port, antenna mounts to top of cabinet, and no external wires to run.

(VII) Add **Subsection 770.12 – Pedestrian Signal Push Button With Integral Sign** to read:

"**(A) Description.** The pedestrian push button unit shall consist of an assembly that can be secured to traffic poles with standard screws, be tamper proof, weatherproof, and constructed so that electrical shocks are impossible to receive.

(B) Materials.

(1) The housing for the push button assembly shall be of cast and/or machined aluminum. The push button assembly shall be weatherproof with a water diverting groove set in the outside diameter of the actuator button receptor. The housing shall be designed to reduce vandalism and shall mount on the side or top of a pole with a minimum 2-inch diameter button. The push button housing shall be capable of mounting in an 'up button' or 'down button' configuration. All wire connections shall be accessible from the back of the assembly.

(2) An ADA acceptable raised directional sign shall be installed with stainless steel fasteners to the housing. The sign shall consist of a raised walking person and a raised arrow indication. Paint the unit black and paint the raised walking person and arrow white. The sign shall be capable of mounting in an 'up button' or 'down button' configuration. The raised walking person and arrows shall be directional and match the indication as shown in the plans.

(3) The pushbutton shall extend from the sign faceplate approximately three inches. The pushbutton actuator shall be convex in design having a flat area on the face for uses of a stylus, ADA acceptable, two inches in diameter, and have a tension of less than five pounds when pressed. The button shall be manufactured in a way that it cannot be stuck in a closed (constant call) position.

(4) The pedestrian push button shall be a piezo electric type and be UL listed. The button shall have a stainless steel actuator and shall be mounted within the housing with stainless steel, non-corrosive, tamper proof fasteners. The unit shall operate between 12-24V DC or AC, 3 inch round mounts with 4 mounting bolts. The pedestrian button shall give an audio and visual signal each time the pedestrian button is activated.

(VIII) Add **Subsection 770.13 – Interconnect/Fabric Subduct** to read:

"770.13 Interconnect/Fabric Subduct.

(A) Description A non-metallic flexible textile raceway known as subduct, which is placed within PVC conduits. The subduct allows for the future communication upgrades to further achieve maximum conduit utilization. The subduct shall consist of flexible, textile material, sometimes referred to as "fabric duct". The subduct shall be installed in the interconnect/fiber optic conduits as indicated on the plans.

(B) Textile **Subduct** The subduct shall consist of the following:

A. Standard Outdoor Textile subduct: Micro (33mm), 2-inch, 3-inch and 4-inch single or multi-cell polyester/nylon textile subduct containing 1250lb polyester flat woven pull tape.

B. Conduit Plugs: Compression-type conduit plugs with locking nuts for sealing and securing one or more textile subducts within a conduit.

C. Pull Tape: The subduct pull tape shall be constructed of synthetic fiber, printed with accurate sequential footage marks and color-coded.

D. Duct Water Seal: products suitable for closing underground and entrance conduit openings where subduct is installed, to prevent entry of gases, liquids, or rodents into the structure.

(C) Installation The contractor shall protect the subduct from the effects of moisture, UV exposure, corrosion and physical damage during installation. The contractor shall install the subduct prior to installing the new interconnect.

The contractor shall provide textile subduct in conduits using continuous unspliced lengths of textile subduct between pull boxes, and/or termination points as indicated on the drawings.

The contractor shall make a 2" incision, approximately 18" from the end of textile subduct. Pull out and cut off approximately 2 feet of pull-tape. Thus allowing the pull tape ends to retract back into the cells.

Using approximately 6 feet of pull tape, tie a non-slip knot to the incision. Then tie 3 to 6 half-hitch knots down to the end of textile subduct. Apply black vinyl tape over all knots and the end of textile subduct. Using a Bow Line knot tie a swivel to the end of 3 feet pull tape. For multi-pack installations one swivel is sufficient, but stagger each textile subduct.

Using a Bow Line knot, attach the pull rope located in the rigid conduit to the other end of the swivel. Install textile subduct - ensuring that no twist is introduced to the subduct

Provide suitable textile subduct slack in the pull boxes, and at turns to ensure there is no kinking or binding of the product.

At locations where textile subduct will be continuous through a pullbox, allow sufficient slack so that the subduct may be secured to the side of the pullbox maintaining the minimum bending radius.

At pullboxes serving as the junction location, pull the exposed end of the subduct to the far end of the pullbox, install termination bag, and secure to the pullbox.

Seal all conduit and textile subduct entering the pullboxes to prevent entrance into the pullboxes of gases, liquids or rodents."

END OF SECTION 770

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
202.1000	Removal of Existing Chain Rail and Posts	L.S.	L.S.	L.S.	$_____
202.2000	Removal of Existing Irrigation Pipes	L.S.	L.S.	L.S.	$_____
203.0100	Roadway Excavation	1,244	C.Y.	$ _____	$_____
203.0200	Borrow Excavated Material	860	C.Y.	$ _____	$_____
204.1000	Trench Excavation for Shared Use Path	2,230	C.Y.	$ _____	$_____
204.2000	Trench Backfill for Shared Use Path (Recycled Asphalt Pavement Placement and Compaction)	L.S.	L.S.	L.S.	$_____
209.0100	Installation, Maintenance, Monitoring, and Removal of BMP	L.S.	L.S.	L.S.	$_____
209.0200	Additional Water Pollution, Dust, and Erosion Control	F.A.	F.A.	F.A.	$ 60,000.00
209.0300	Hazardous Materials Mitigation	F.A.	F.A.	F.A.	$ 100,000.00
301.1000	Hot Mix Asphalt Base Course	1,070	Ton	$ _____	$_____
305.1000	Aggregate Subbase	1,220	C.Y.	$ _____	$_____
315.1000	Non-Woven Geotextile Fabric (Shared Use Path)	4,300	S.Y.	$ _____	$_____
401.1000	HMA Pavement, Mix No. IV	4,746	Ton	$ _____	$_____
401.1100	HMA Pavement, Mix No.IV (Under the guardrail)	32	Ton	$ _____	$_____

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
401.2000	HMA Pavement, Mix No. IV (Shared Use Path)	810	Ton	$ _____	$_____
414.0100	Excavation of Weakened Pavement Areas	109	C.Y.	$ _____	$_____
415.1000	Cold Planing	25,640	S.Y.	$ _____	$_____
603.9000	Clean Existing Culverts	F.A.	F.A.	F.A.	$ 60,000.00
604.0100	Type D Catch Basin (3.00 to 3.99 Feet)	2	EA	$ _____	$_____
604.1000	Adjusting HECO Manhole Cast Iron Frame and Cover	3	EA	$ _____	$_____
604.2000	Adjusting Hawaiian Telcom Manhole Cast Iron Frame and Cover	5	EA	$ _____	$_____
604.3000	Adjusting TV (Spectrum) Manhole Cast Iron Frame and Cover	2	EA	$ _____	$_____
604.4000	Adjusting Traffic Signal Pullbox Frame and Cover	3	EA	$ _____	$_____
604.4100	Adjusting Traffic Signal Pullbox Frame and Cover (Shared Use Path)	2	EA	$ _____	$_____
604.5000	Adjusting Street Light Pullbox Frame and Cover	3	EA	$ _____	$_____
604.5100	Adjusting Street Light Pullbox Frame and Cover (Shared Use Path)	4	EA	$ _____	$_____
606.1000	Guardrail Type MGS	1,250	L.F.	$ _____	$_____
606.2000	Terminal Section Type MGS	2	EA	$ _____	$_____

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
612.1000	Grouted Rubble Paving	8	C.Y.	$ _____	$_____
621.1000	EVC System	L.S.	L.S.	L.S.	$_____
623.1010	Traffic Signal System (Kapolei Parkway)	L.S.	L.S.	L.S.	$_____
623.1020	Traffic Signal System (Roosevelt Avenue)	L.S.	L.S.	L.S.	$_____
623.2010	Traffic Signal Interconnect	L.S.	L.S.	L.S.	$_____
626.1000	Adjusting BWS Water Manhole Frame and Cover	3	EA	$ _____	$_____
626.2000	Adjusting BWS Water Meter Frame and Cover	1	EA	$ _____	$_____
626.3000	Adjusting BWS Water Standard Valve Box	1	EA	$ _____	$_____
626.4000	Adjusting Sewer Manhole Frame and Cover (Shared Use Path)	1	EA	$ _____	$_____
627.1010	Pathway Lighting System (Excluding Pole Base Foundations)	L.S.	L.S.	L.S.	$_____
627.1011	Pathway Light Pole Base Foundations	L.S.	L.S.	L.S.	$_____
627.1020	Power System for Traffic Signal and Railroad Crossing Controllers	L.S.	L.S.	L.S.	$_____
629.1010	Double 4-Inch Pavement Striping (Thermoplastic Extrusion)	5,858	L.F.	$ _____	$_____
629.1011	4-Inch Pavement Striping (Thermoplastic Extrusion)	2,024	L.F.	$ _____	$_____

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
629.1012	4-Inch Pavement Striping – Guide Line (Thermoplastic Extrusion)	2,910	L.F.	$ _____	$_____
629.1013	4-Inch Pavement Striping – Shared-Use Path (Thermoplastic Extrusion)	12,887	L.F.	$ _____	$_____
629.1014	6-Inch Pavement Striping (Thermoplastic Extrusion)	12,144	L.F.	$ _____	$_____
629.1015	8-Inch Pavement Striping (Thermoplastic Extrusion)	2,629	L.F.	$ _____	$_____
629.1016	12-Inch Pavement Striping – Diagonal (Thermoplastic Extrusion)	1,243	L.F.	$ _____	$_____
629.2010	12-Inch Stop Bar (Thermoplastic Extrusion)	344	L.F.	$ _____	$_____
629.2011	24-Inch Stop Bar (Thermoplastic Extrusion)	50	L.F.	$ _____	$_____
629.2012	4-Inch Lane Striping (10-Foot Profiled Thermoplastic Extrusion)	4,472	L.F.	$ _____	$_____
629.3010	Crosswalk Marking (Thermoplastic Extrusion)	47	Lane	$ _____	$_____
629.3011	Pavement Arrows (Thermoplastic Extrusion)	87	EA	$ _____	$_____
629.3012	Pavement Word (Thermoplastic Extrusion)	14	EA	$ _____	$_____
629.3013	Pavement Symbol – Yield Line (Thermoplastic Extrusion)	3	EA	$ _____	$_____
629.3014	Pavement Symbol – Railroad Crossing (Thermoplastic Extrusion)	2	EA	$ _____	$_____
629.3015	Pavement Symbol – Bike Lane (Thermoplastic Extrusion)	4	EA	$ _____	$_____

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
629.4010	Type “C” Pavement Marker	538	EA	$ _____	$_____
629.4011	Type “D” Pavement Marker	66	EA	$ _____	$_____
629.4012	Type “F” Pavement Marker (Fire Hydrant)	6	EA	$ _____	$_____
629.4013	Type “H” Pavement Marker	304	EA	$ _____	$_____
629.5010	Curb Markings – Shared-Use Path (Paint, White)	2,376	L.F.	$ _____	$_____
631.1010	Regulatory Sign (10 Square Feet or Less)	16	EA	$ _____	$_____
631.1020	Regulatory Sign (10 Square Feet or Less) with Post(s)	30	EA	$ _____	$_____
631.1030	Regulatory Sign (More than 10 Square Feet) with Post(s)	23	EA	$ _____	$_____
631.2010	Warning Sign (10 Square Feet or Less)	2	EA	$ _____	$_____
631.2020	Warning Sign (10 Square Feet or Less) with Post(s)	7	EA	$ _____	$_____
631.3010	Directional Sign (10 Square Feet or Less)	8	EA	$ _____	$_____
631.3020	Directional Sign (10 Square Feet or Less) with Post(s)	5	EA	$ _____	$_____
631.3030	Street Name Sign on Mast Arm	6	EA	$ _____	$_____
631.4010	Relocation of Existing Sign	4	EA	$ _____	$_____

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
631.4020	Relocation of Existing Sign with New Post(s)	4	EA	$ _____	$_____
632.0100	Reflector Marker RM-3 with Flexible Post (Type A, 36" high, White)	197	EA	$ _____	$_____
632.0200	Reflector Marker RM-5 Mounted on New Guardrail (White)	57	EA	$ _____	$_____
632.0420	Milepost Marker and Route Number Plate with Post (Bi-Directional)	2	EA	$ _____	$_____
634.1000	Portland Cement Concrete Sidewalk	249	S.Y.	$ _____	$_____
634.2000	Portland Cement Concrete Ramp	L.S.	L.S.	L.S.	$_____
638.1000	Curb, Type 2D	343	L.F.	$ _____	$_____
638.1010	City & County Concrete Curb	9	L.F.	$ _____	$_____
638.2000	Curb and Gutter, Type 2DG	32	L.F.	$ _____	$_____
638.2010	City & County Integral Curb & Gutter	229	L.F.	$ _____	$_____
638.2020	Modified Gutter	9	L.F.	$ _____	$_____
638.3000	Pre-Cast Concrete Parking Curb	360	EA	$ _____	$_____
641.0100	Hydro-mulch Seeding	L.S.	L.S.	L.S.	$_____
643.0200	Maintenance of Existing Landscape Areas	F.A.	F.A.	F.A.	$ 5,000.00

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
645.0100	Traffic Control	L.S.	L.S.	L.S.	$_____
645.0200	Additional Police Officers, Additional Traffic Control Devices, and Advertisement	F.A.	F.A.	F.A.	$ 80,000.00
648.0100	Field-Posted Drawings	L.S.	L.S.	L.S.	$_____
650.1000	Curb Ramp, Type A	L.S.	L.S.	L.S.	$_____
650.2000	Curb Ramp, Type B Modified	L.S.	L.S.	L.S.	$_____
650.3000	Modification of Existing Curb Ramp, Type C	L.S.	L.S.	L.S.	$_____
650.4000	Curb Ramp, Type D	L.S.	L.S.	L.S.	$_____
650.5000	Detectable Warning Mat	7	EA	$ _____	$_____
660.1000	Railroad Signal System	L.S.	L.S.	L.S.	$_____
661.1000	Railroad Track Construction	L.S.	L.S.	L.S.	$_____
694.1000	Longitudinal Channelizing Curb System	27	Unit	$ _____	$_____
695.1000	State-Furnished Portable Concrete Barrier	50	EA	$ _____	$_____
695.2000	Inertial Barrier System	L.S.	L.S.	L.S.	$_____
696.1000	Maintenance of Trailers	F.A.	F.A.	F.A.	$ 50,000.00

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
699.1000	Mobilization (Not to Exceed 6 Percent of the Sum of All Items Excluding the Bid Price of this Item)	L.S.	L.S.	L.S.	$_____

Total Amount for Comparison of Bids ……. $ _____

NOTE: Bidders must complete all unit prices and amounts. Failure to do so may be grounds for rejection of bid.

PROPOSAL SCHEDULE

The bidder is directed to Subsection 105.16 – Subcontracts.

The bidder's attention is directed to Sections 696 - Field Office and Project Site Laboratory and 699 - Mobilization for the limitation of the amount bidders are allowed to bid.

If the bid price for any proposal item having a maximum allowable bid indicated therefore in any of the contract documents is in excess of such a maximum amount, the bid price for such proposal item shall be adjusted to reflect the limitation thereon. The comparison of bids to determine the successful bidder and the amount of contract to be awarded shall be determined after such adjustments are made, and such adjustments shall be binding upon the bidder. The Total Amount for Comparison of Bids will determine the lowest responsible bidder.

The bidder is directed to Section 717 – Cullet and Cullet-Made Materials regarding recycling of waste glass.

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

Project: FORT BARRETTE ROAD OPERATIONAL IMPROVEMENTS, ROOSEVELT AVENUE TO FARRINGTON HIGHWAY PROJECT NO. 901A-01-19

Prospective bidders had emailed RFI's. Questions and responses are as follows:

1. I was looking through the plans and saw call outs for gate posts. Are these existing gate posts? If not, what items do these gate posts belong to? Please advise.

   Response: These are referring to the new gate posts for the upgraded railroad crossing. Refer to the Railroad Crossing Plans.

2. I saw the new quantity for the cold planing in the new addendum, but from my takeoff, I only have a quantity of 24,200 SY of cold planing. Did you include the reconstruction area into the cold planing quantity, or is there any extra work that I could be missing that's not in between es to es of the existing roadway?

   Response: The reconstruction area is included in the cold planing quantity according to Detail B on sheet ADD. 15. However, I noticed an error in the calculation. See Addendum No. 3 for revision. Note that the quantity is approximate. The cold planing area is just between the es and es of the existing roadway.

3. Does item no. 414.01000 Excavation of Weakened Pavement Areas only applies to the recon areas? If so, since the top layer is being cold planed, only 5" of material needs to be excavated and that would again lower the quantity for the item. Please advise.

   Response: Yes that is correct. See Addendum No. 3 for correction to quantity.

4. Bid Item No. 631.1010 – Regulatory Sign (10 Square Feet or Less) indicates 4 each signs. However, I've counted 6 each signs on the drawings.

   Response: See Addendum No. 3 for clarification.

5. Bid Item No. 631.1020 – Regulatory Sign (10 Square Feet or Less) with Post(s) indicates 31 each signs. However, I've counted only 27 each signs on the drawings.

   Response: See Addendum No. 3 for clarification.

6. Bid Item No. 631.1020 – Regulatory Sign (More Than 10 Square Feet) with Post(s) indicates 13 each signs. However, I've counted 14 each signs on the drawings.

Response: See Addendum No. 3 for clarification.

7. Bid Item No. 631.2010 – Warning Sign (10 Square Feet or Less) indicates 6 each signs. However, I've counted only 4 each signs on the drawings.

Response: See Addendum No. 3 for clarification.

8. Bid Item No. 631.2020 – Warning Sign (10 Square Feet or Less) with Post(s) indicates 12 each signs. However, I've counted only 10 each signs on the drawings.

Response: See Addendum No. 3 for clarification.

9. Bid Item No. 631.3010 – Directional Sign (10 Square Feet or Less) indicates 12 each signs. However, I've counted only 8 each signs on the drawings.

Response: See Addendum No. 3 for clarification.

10. Bid Item No. 632.0400 – Milepost Marker with Post (Bi-Directional) indicates 2 each signs. However, I don't see any milepost markers on the drawings.

Response: See Addendum No. 3 for clarification.

11. Traffic Signal Plan Sheets 105, 107 & 113 show street name signs on mast arm. Is there a bid item number for the street name signs?

Response: Added new pay item for 6 street name signs. Note that signs are double-sided, so each hanging sign counts as one. See revised Section 631 and Proposal Schedule in Addendum No. 3.

12. Traffic Signal Plan Sheets 105 & 107 show left turn signs on mast arm. Is there a bid item number for the left turn signs?

Response: Quantity revised. See revised Proposal Schedule in Addendum No. 3.

13. Bid Item No. 638.3000 – Pre-Cast Concrete Parking Curb. Please provide an approximate quantity. I could not determine the exact quantity required.

Response: See Addendum No. 3 for clarification.

14. Current practice is to use Programmed Visibility Signals for Protected Left Turn signals mounted on a Mast Arm. For Drawing TS-2, should signals "B-1" and "G-1" be Programmed Visibility Signals?

Response: See Addendum No. 3 plans. There are no Protected Left Turn Signals.

15. Surrounding Traffic Signals on Fort Barrette Road and Kapolei Parkway each have a Traffic CCTV Camera, please confirm that Fort Barrette Road at Roosevelt Avenue does not have a Traffic CCTV Camera.

Response: Confirmed that Traffic CCTV Camera is not included in Fort Barrette Road & Roosevelt Avenue traffic signal design.

16. I checked with both Ameron and Hawaiian Cement in regards to the ballast material being called out for the railroad track construction. They both don't produce this type of aggregate. Please advise whether to change the ballast material or import material in.

Response: Confirmed that there is a supplier on-island who is able to supply the specified ballast material by special order for this project and has also done so for previous projects with railroad work.

17. On plan sheet 60 there is a call out for #7 Airplane Symbol and Arrow (install New Sign), but the picture of dotted sign seems like relocate. Also what pay item will this be paid under?

Response: See Addendum No. 3 plans. The callout was changed to "relocate existing sign." There are pay items for relocation of existing signs (with and without post).

18. There is a symbol for RM-2s on sheet 52, but there is no pay item for them. Also on sheet 52 there is a symbol for Anchor contraflow base, but there is no pay item for it.

Response: There is no work for RM-2 in this project. The symbol has been removed. The anchor post symbol has been removed also. See Addendum No. 3 plans.

19. There is a pay item for Mile Post Marker but no call out on the plan sheets.

Response: See Addendum No. 3 plans. Mile Post Markers have been included.

20. For Concrete Parking Curb, can it be 6 inches high? That is the standard size locally used made by local manufacturer? Also what is the pay item for the concrete curb?

Response: 6 inch height is acceptable as it is the standard size provided by local manufacturers. The pay item is 638.3000 Pre-Cast Concrete Parking Curb.

21. For Add Sheet 20 what were the changes that were made?

Response: See sheet ADD. 20 in Addendum No. 3 for clarification.

22. Item 202.1000 - Remove Chain Rail and Post [sheet 34] shows Roosevelt Avenue Sta. 1+49 to 9+98, approx 849 l.f. "Remove and dispose existing chain rail and posts." Actual field inspection shows only a short run. Is this the extent of the removal?

Response: The extents are from Roosevelt Avenue BL Sta. 1+49 to the Right-of-Way (R/W) BL Sta. 9+98. The length would be less than what is stated in the question.

23. For bid item 629.5011 Tubular Delineators, 207 each, is there a detail on the delineator as to type and installation whether Epoxy Base or Driven? Also Delineators not shown on drawings. Where do they go?

Response: See Addendum No. 3 for clarification. The contract item has been revised: 632.0420 – Reflector Marker RM-3 with Flexible Post (Type A, 36" high, White) (197 EA). Type A is ground mounted (on paved areas) with a base. See sheet ADD. 62.

24. Could you clarify exactly where the work zone signs, as shown on sheet 54, be placed? Since there are major cross streets, do they go on both ends of the cross streets? Which signs go where?

Response: Ground-mounted (permanent) construction signs would be required for both approaches to project limits on Fort Barrette Road only as shown in the plan.

25. Please confirm that traffic signal conduits shown on sheets TS-2, TS-4, TS-14 & TS-15 are direct buried in non-paved areas and concrete encased in paved areas as shown on restoration Dwg No. TS-6 since there are no ductline duct section plans, only table showing number of ducts and cables.

Response: Plans have been revised to show traffic signal conduits as concrete encased. See Addendum No. 3 plans for clarification.

26. Is there a phasing plan that contractors will be held to?

Response: There is no phasing plan. See sheet ADD. 52S-1 in Addendum No. 3 for traffic control notes for construction coordination and construction coordination map.

27. Concerning the railroad construction, will the contractor be allowed to close the road in this section and detour traffic? To provide the best product for the users of the rail, the track should be installed in one continuous length which will require total road closure. If the road cannot be closed, how did the State envision the contractor to perform the work?

Response: Yes, the contract will allow full roadway closure for 3 days. See Addendum No. 3 Special Provision Section 645 – Work Zone Traffic Control for clarification.

28. Will night work be allowed?

Response: No night work will be allowed.

29. What are the limits of the railroad track construction? We need to know the limits of the 6" asphalt repair. Sheet 123 doesn't show how far the 6" AC pavement repair is. This section is 3" deeper than the rest of the paving on Fort Barrette and is reinforced with Glasgrid.

Response: See Sheet ADD. 123 for clarification.

30. How were the railroad specifications formed? Was the Hawaiian Rail Society involved in the development of these specs?

Response: Railroad specifications follow previous railroad construction work for Hawaiian Railway Society (HRS). HRS has been involved in the development of these specifications.

31. The ballast material specified in Section 661 is not available locally on Oahu. Was there a source that the State had in mind that conforms to these specs?

Response: See Response to #16.

32. What is included in the Roadway Excavation item? Does it included electrical trenching, roadway widening, and railroad work?

Response: Pay item 203.0100 Roadway Excavation only includes roadway widening work. All electrical work is included in the pay items under

Section 627 – Pathway Lighting System. All railroad work is included in the pay items under Section 660 – Railroad Signal System and Section 661 – Railroad Track Construction.

33. What is included in the Trench Excavation and Trench Backfill items? Is this for the pathways only?

Response: **Pay item 204.1000 Trench Excavation for Shared Use Path includes the excavation for the Shared Use Path. Pay item 204.2000 Trench Backfill for Shared Use Path (Recycled Asphalt Pavement Placement and Compaction) includes the placement and compaction of the Recycled Asphalt Pavement in the Shared Use Path.**

34. Item 202.2000 is for removal of irrigation pipes. Do these pipes contain asbestos or any other hazardous material?

Response: **Hazardous materials may be present. See revised Section 209 – Temporary Water Pollution, Dust, and Erosion Control, specifically Sections 209.03(H), 209.04(C), and 209.05, revised Proposal Schedule including new pay item 209.0300 Hazardous Materials Mitigation, and sheet ADD. 39 in Addendum No. 3 for clarification.**

35. Is there a pre-substitution process to allow alternates for the Fixture Head, Pole and Bases (Pathway Light) described on Sheets E-21 & E-22? If there is no pre-substitution process will alternates be reviewed during the submittal process?

Response: **Refer to Special Provisions Subsection 102.14 – Substitution of Materials and Equipment Before Bid Opening for the process prior to bid opening. Refer to Special Provisions Subsection 106.13 – Substitution of Materials and Equipment after Bid Opening for the process after bid opening.**