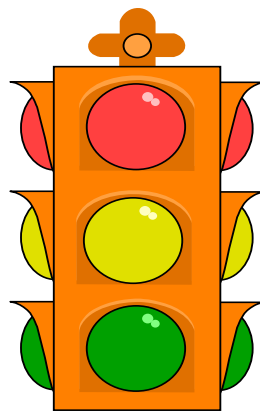


APPENDIX D



Traffic Signal Design Manual And Technical Specifications



City of Puyallup
Development Services
Traffic Engineering Division

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FOREWORD

This manual establishes uniform procedures for the design preparation of traffic signal plans and installation of traffic signals in the City of Puyallup. It is not intended as a textbook or as a substitute for solid working knowledge, experience, and judgement of the principles of traffic signal design, but rather as a guideline to uniformity and to provide the Designer with sufficient information to prepare the desired plans with a minimal uncertainty.

I. GENERAL TRAFFIC SIGNAL DESIGN REQUIREMENTS

The Designer responsible to design the traffic signal shall rely on the latest editions of the following sources:

- City of Puyallup's *Traffic Signal Design Manual and Technical Specifications*.
- Washington State Department of Transportation (WSDOT) *Standard Plans and Specifications and Design Manual*.
- *City of Puyallup Standard Special Provisions*. Special Provisions 8-20 and 9-29 can be found in this document under Sections V and VI.
- *City of Puyallup Standards for Public Works Engineering and Construction* .
- *Manual of Uniform Traffic Control Devices* (MUTCD) recommended design practices adopted by WSDOT, where applicable.
- AASHTO, *A Policy on Geometric Design of Highways and Streets*.
- Institute of Transportation Engineers' *Manual of Traffic Signal Design*.
- U.S.D.O.T. *Railroad-Highway Grade Crossing Handbook*.
- Institute of Transportation Engineers' *Preemption of Traffic Signals at or Near Railroad Grade Crossing with Active Warning Devices*.
- National Electric Code (NEC).

In addition, the Designer shall coordinate with the utility provider for service points and type of service and address any conflicts. The traffic signal system shall be metered through its own circuit and shall be separated from any transit shelter, irrigation, flashing beacon, street lights, and/or other electrical devices not related to the traffic signal and its equipment. The Designer shall be a registered Civil Engineer with the State of Washington and shall seal and sign the final Plans and Special Provisions.

II. SIGNAL WARRANT ANALYSIS, ENGINEERING STUDY, and DESIGN PROCESS

The following guidelines describe the typical process for the determination and basis of design for a typical traffic signal within the City of Puyallup. The Signal Designer shall set up a meeting with the City's Traffic Engineer to discuss the specific requirements of the project after reviewing this document and prior to beginning work.

A. Signal Warrant Analysis

The City requires any proposed signal within the city to meet at least one of the eight signal warrants with signal warrants 1 (Eight-Hour Vehicular Volume) and 2 (Four-Hour Vehicular Volume) being of the greatest concern. Definitions and requirements for traffic signal warrants can be found in the MUTCD. A signal warrant is a minimum condition in which a signal may be installed. However, satisfying a warrant does not mandate the installation of a traffic signal as stated in the MUTCD. A warranting condition only indicates that an engineering study is required to determine whether the signal is justified or other options can be considered over the investment of a signal.

B. Engineering Study

An engineering study is required for every proposed traffic signal. Typically, the study includes the level-of-service (LOS) analysis of the signal for weekday AM and PM peak hours. Depending on the location and circumstances, a LOS analysis may be required for other peak hour times as well. The goal is to provide an intersection design adequate enough to obtain LOS D or better at the intersection. A queue length analysis is also required to determine the appropriate lane configurations and turn lane lengths needed for the intersection. Pedestrian counts and prediction of increased pedestrian use with the new signal should also be addressed in the engineering study. Knowledge of recommended student walking routes, high pedestrian generators, city parks, and other public facilities should be considered.

Based on the results of the engineering study, the appropriate number of lanes, length of turning lanes, and signal phasing will be determined. Close coordination with the City is required throughout the engineering study to develop the optimal intersection configuration and to accommodate future transportation improvement plans.

The turning movement volumes will also be used by City staff to develop signal timing plans for various peak periods during the weekdays and weekends. Prior to gathering volume counts, the Signal Designer shall discuss location and times of each count as more counts than just the design intersection may be needed if its planned to be interconnected within a larger signal system.

C. Signal Phasing

When determining the appropriate signal phasing in the engineering study, the City has the following preferences:

- When left turn volumes and/or opposing volumes are such that left-turn phasing is required (as determined by the engineering study), the City would prefer protected/permissive doghouse phasing. Protected/permissive left-turn phasing is allowed only for single lane left turn movement. When left turn volumes exceed 250vph during the peak hour,

protected/permissive phasing may not provide the level of safety needed and therefore, protected-only phasing should be studied.

- If the engineering study determines that dual left turn lanes are needed for one or more direction, then protected-only phasing will be required.
- Right-turn overlap phasing should be considered at locations with a dedicated right-turn lane where the intersecting street has a complimentary protected left-turn movement and U-turns are prohibited. However, the overlap phase design should take into account any concurrent pedestrian movements that could cause a point of conflict with the right-turning vehicles.
- Railroad preemption phasing is required at all signalized intersections when the nearest rail of a railroad crossing is within 200 feet of the stop bar to any leg of the intersection. Preemption for intersections beyond 200 feet from the intersection stop line is only considered when the queue on that approach routinely occupies the crossing. If railroad preemption is needed, careful coordination with BNSF or UP railroad personnel will be required to coordinate the interconnection design needs. Blank out signs should be considered for conflicting phases during the pre-emption operation and a secondary signal in advance of the tracks for approaching traffic. Whenever possible, the advance signal (repeater signal) should utilize the railroad cantilever arm.
- The City does not recommend split phasing (e.g. exclusive service by direction versus concurrent service) unless no other feasible alternative exists for the intersection due to geometric constraints.
- At “T” intersections, the Designer should consider overlap phasing for the non-conflicting movements if not in conflict with pedestrian needs and operation. Also, multi-lane intersections on the stem of the “T” may be good candidates for Florida T operation and this type of operation should be considered early-on in the design process.

D. Design Submittal Process

Typically, four submittals are required for approval of the design report and construction signal plans. These submittals relate to 100 percent design report, 50 percent construction plans, 90 percent construction plans and specifications, and 100 percent construction plans and specifications. All traffic signal construction plans shall be submitted on 24”x36” sheets and the design report and specifications shall be comb-bounded.

When the City fast tracks the construction of the traffic signal, plans and specifications shall be prepared to allow for agency bid and purchase of the required signal poles. The signal construction plans would specify that the equipment will be provided by the city with the successful contractor moving the poles from the City’s Corporate Yard (located at 1100 39th Avenue SE, Puyallup) to the project site.

1. First Submittal –

The first submittal shall include three copies of the complete design report that includes traffic volume data, signal warrant analysis, LOS computations, queue length analysis, and recommended phasing, lane configuration (channelization plans), and lane lengths. If more than one option was studied, the preferred option should be recommended and a set of channelization plans be prepared and submitted with the first submittal. The initial plan review fee shall be submitted at this stage.

2. *Second Submittal* -

The second (50 percent) submittal shall include a cover sheet and a signal plan sheet. The cover sheet shall contain all items as outlined in Section III-A of this document. The signal plan sheet shall contain the proposed location of curbs, construction centerlines, lane configuration and striping, proposed locations of the signal poles, controller, power source location and service equipment, existing utilities including overhead wires and right-of-way information, proposed right-of-way easements, phase diagram, peak hour traffic volumes by direction, legend, signal, and pedestrian head locations, numbering and displays, sign locations and displays, and video detection and numbering. Four sets of check prints are required for the second submittal.

3. *Third Submittal* -

The third (90 percent) submittal shall include all additional items as outlined in Section III of this manual. Four sets of check prints are required for the second submittal. The third submittal shall also include four sets of the contract documents with Special Provisions for review and a list of items to be removed if the design includes a modification to an existing signal. The City will review the list of items and notify the Designer the items to be salvaged and returned to the City. The Designer shall include the list of items to be salvaged in the Special Provisions. The most recent copy of the Special Provisions can be found in Sections V and VI of this document and an electronic copy can be provided that should be used as a start for preparing the specifications. Any changes to the City's Special Provisions shall be done in strike-out mode so that changes are apparent.

Prior to the 90 percent submittal, the Designer shall coordinate an effort to pothole locations of the proposed signal poles to identify any existing utility conflicts.

4. *Fourth Submittal* -

If there are no outstanding design issues after the third submittal, the fourth (100 percent) submittal shall be one set of Mylar drawings and one set of contract documents for approval signatures. These drawings and contract documents shall be signed and sealed by a Civil Engineer with a current Washington Professional Engineering license and contain a Standard City Approval Block.

Once the Mylars and contract documents are signed by the City, the Designer shall pick up the documents and arrange to have 8 full-size set of prints and 8 comb-bound contract documents made with 2 half-size set of prints made. Additional sets may be required by the City Traffic Engineer. Full-size print sets and bound contract documents shall be numbered. Print sets along with bound contract documents, Mylars, original unbound contract documents, and electronic files of both Mylars and contract documents shall be provided back to the City.

If outstanding design issues exist, the City may require the Signal Designer to submit four sets of check prints again for review and comment, prior to the final (100 percent) submittal.

III. PLAN GUIDELINES

The following are the City's guidelines regarding the format of the signal plans.

A. Cover Sheet

If the signal design is a stand-alone project, the plans shall have a cover sheet. If the signal design is a part of a larger plan set, a cover sheet just for the signal design is not necessary. The cover sheet shall include:

- Project name and number with a City logo and any Grant Funding number, if applicable.
- Vicinity map showing the project site and surrounding roads (up to an approximate 5-block radius).
- Sheet index.
- Signal legend of existing and proposed items and shall be drafted in accordance with APWA symbols. If a cover sheet is not necessary, the signal legend shall be located on the signal plan sheet.
- City of Puyallup signature block showing approval.
- General Notes applicable to all phases of the project.

B. Demolition Plan

Demolition plan when needed should show all items that are in need of removal. This plan may be needed even if the signal improvements are not to an existing system. Removal items including curbs, conflicting striping, pavement, poles, sidewalk, sawcut limits, vegetation, and walls should be shown on this sheet. Items that are to be salvaged to the City's Corporate Yard (located at 1100 39th Avenue SE, Puyallup) should be identified on this plan as well. Include any demolition notes on this sheet.

C. Signal Plan

At times, the signal plan can contain too much information to place on one sheet. For plans that require two sheets, the City suggests the first sheet to contain the intersection plan and the second sheet to contain the legs of the intersection. Match lines should be included to provide connectivity between the two sheets. The Designer should try to avoid repetitive information on the sheets (e.g. junction box schedule, junction box schedule notes, general notes, construction notes, phasing diagram, and signal display should be shown on the first sheet). The Designer should keep in mind that the plans used in the field will probably be at half-size, so the plans should be clear and easy to read at half-size.

1. *Signal Plan: Base Sheet and Title Block -*

The Signal Plan shall conform to the following requirements:

- North shall always be oriented up or to the right on all plans. The major arterial shall be horizontal on the plan.
- The Signal Plan shall be drawn at a 1"=20' scale. A scale block shall be included on the plan. For areas that require greater detail (such as the corner that has the controller), a blown-up detail may be necessary at a 1"=10' scale.

- All proposed signal equipment, including signal poles, mast arms, signal heads, mast arm signs, junction boxes, conduits, video cameras, controller, and service cabinet shall be shown as bold.
- All existing and proposed right-of-way information shall be shown and labeled on the plan, including easements needed for signal equipment. The line type shall be different for easements and right-of-way – proposed and existing.
- All proposed curbs, sidewalks, and pavement shall not be shown screened back, but of a lighter pen weight. Proposed striping and existing curb/striping (to remain) information shall be shown on the plan in gray scale (screened back).
- Construction centerlines for each road are required, with equations to existing monuments. Stationing shall be labeled every 100 feet.
- All proposed and existing underground and overhead utilities shall be shown and labeled on the plan in gray scale.
- A City of Puyallup signature block showing approval shall be included on the signal plan sheet.

2. *Signal Plan: General and Construction Notes -*

The Signal Plan sheet shall include applicable general notes. General notes shall include, but not be limited to:

GENERAL NOTES

1. Vehicle and pedestrian head mounting type.
2. Pedestrian push button type.
3. The location of all conduits, junction boxes, poles, and cabinets shown on this plan may be slightly adjusted in the field to avoid conflicts. All final locations shall be approved by the City Traffic Engineer or the assigned City Inspector prior to construction.
4. All new foundation locations shall be approved by the City Traffic Engineer or the assigned City Inspector prior to excavation. Contractor shall check for minimum overhead clearance of 16'-6" for all signal heads above the street prior to pouring the foundation.
5. All traffic signal and pedestrian heads and push buttons shall be securely and completely covered while signal is not in operation. Signal heads will be bagged with a small hole in line with each signal lens.
6. All conductors for signal heads, cameras, pedestrian heads, push buttons, EVP equipment, and streetlights shall be labeled in each junction box.
7. All conduits shall be rigid hot-dipped galvanized steel when exposed above the ground or schedule 80 PVC, unless approved otherwise by the City.
8. All signs shall be VIP diamond grade sheeting for both mast arms and shoulder mounts.
9. Street name signs shall be LED lighted units with the City's daffodil logo.
10. All work shall be in accordance with City of Puyallup Standards and Specifications.
11. The locations of features shown are approximate and shall be verified in the field by the contractor as necessary.
12. All work shall be consistent with utility agency requirements. The Contractor shall contact all pertinent utility agencies 48 hours before commencing work, and shall coordinate with affected utility agencies throughout the project.
13. The Contractor shall be responsible for any damage to existing utilities. The contractor shall notify the affected utility company and the City of Puyallup immediately upon damage.
14. Adjust luminaire arms to put luminaire 3' over roadway per City of Puyallup standard 114.4.

The Signal Plan sheet shall include applicable construction notes. Construction notes shall include the needed information, which this list may not be inclusive:

CONSTRUCTION NOTES

1. Each signal pole shall be numbered corresponding to its construction note number. The note shall include the following information: station, offset and direction, pole foundation installation information, pole type, mast arm length, luminaire wattage, and list of number and items to be installed on the pole.
2. Station, offset and direction for installation of controller cabinet with orientation of front door opening (access to front of controller and electronic components) and foundation. Include applicable information or reference details.
3. Station, offset and direction for installation of service cabinet and foundation. Include applicable information or reference details.
4. Coordination of utility removal/relocation.
5. Instructions to the Contractor of his limits of work depended on connection type and limits of work that shall be done by utility company (PSE). The Contractor to assure coordination of work to provide for connection of power.
6. Additional opticom notes if not completely addressed in note one.
7. Additional video detection notes if not completely addressed in note one.
8. Additional PTZ camera notes if not completely addressed in note one.
9. Additional Battery Backup System (BBS) notes if not completely addressed in note one.
10. Additional Broadband Antenna notes if not completely addressed in note one.
11. Additional information related to Interconnect to other signals.
12. Railroad interconnect information and coordination with railroad personnel.
13. Removal of existing signal and/or street lighting equipment and any salvage information.

3. *Signal Plan: Signal Display, Display Notes, and Phasing Diagram -*

- Provide signal display graphics for each vehicle signal head and typical pedestrian signal head with reference phase number. Specify on the graphic if the vehicle head is standard or optically programmed.
- Include the following display notes next to the signal display graphics.

DISPLAY NOTES

1. All standard vehicle signal heads shall be conventional Aluminum type with 12-inch lens for all indications and square doors equipped with tunnel visors. Each signal head shall have a 0.25-inch hole drilled into the bottom. Balls and arrows shall be illuminated with Dialight ITE Specification LED lights for all indications.
 2. All pedestrian heads shall be Countdown and ITE Specification LED light units by Dialight with Black Z-crate visors. Hand shall be Portland Orange and man shall be Lunar White.
 3. Pedestrian heads, vehicle heads, and back-plates shall be aluminum and flat black in color.
- Near the signal display graphics and signal display notes, provide a phase diagram for the proposed system. If the system is to be modified in the future, include a future phase diagram adjacent to the proposed phase diagram and label accordingly.

4. *Detection -*

All vehicular detection shall be by cameras mounted on the signal or luminaire mast arm. Include the location of the cameras in the appropriate construction notes.

5. *Signal Poles and Associated Equipment -*

The Signal Plan shall contain, but not be limited to:

- All signal pole locations and numbering within a hexagonal circle. Signal pole shall be drawn in bold with street light and mast arm in direction of orientation specified.
- Signal head location, directional arrow, and numbering.
- Pedestrian head location, directional arrow, and numbering.

6. *Controller and Service Location -*

The footprint of the foundation shall be shown on the plans with the controller and service cabinets oriented on the foundation, as they would be placed in the field. If the information required for all the controller/service conduit connections and foundation footprint makes the plan too cluttered, a blown-up detail of the corner containing this information is needed at a 1" = 10' scale. The location of the power source shall be identified on the plans as well.

7. *Interconnect -*

If signal or railroad interconnect is included with the design, it shall be identified on the Signal Plan and Signal Wiring schedule to the limit of the signal improvements. A separate interconnect plan may be necessary to indicate the route and connection to the adjacent signal or railroad bungalow. The plans shall include wire/conduit notes, junction box locations, and construction notes as appropriate.

8. *Conduit/Wiring Schedule -*

A conduit/wiring schedule shall include run numbers (referenced with a triangle on the Signal Plan), conduit size, wire type, device (e.g. vehicle detection, preemption detection, preemption confirmation light, vehicle head, pedestrian head, pedestrian button, lighted street name sign, illumination, and power), pull cord when applicable, and comments.

- For designs that include modifications to an existing signal, all existing wire runs affected by the design shall be shown on the wiring schedule.
- If the wiring schedule does not fit on the Signal Plan, it may be included on a sheet with the cabinet wiring diagram.

9. *Junction box type and approximate location -*

The City prefers that junction box information be shown in a table labeled junction box schedule with junction box schedule notes adjacent to it. A sample of this format is indicated below. Note letter in schedule is referenced on the Signal Plan for each junction box. The Remarks number refers to junction box schedule notes for additional information required for correct installation.

TABLE III-1

JUNCTION BOX SCHEDULE				
Note No	Type	Station	Offset to CL	Notes
A	3	99+43	32'	(1)
B	3	99+56	52'	(1)
C	2	99+58	39'	
D	1	10+60	20'	
E	1	98+30	28'	(3)
F	2	99+42	24'	
G	1	99+46	28'	
H	1	9+49	37'	
I	1	8+17	37'	
J	2	9+64	30'	(7)
K	1	9+71	33'	
L	3	10+65	26'	(5)(6)
M	1	10+65	30'	
N	1	11+92	30'	(4)

<u>JUNCTION BOX SCHEDULE NOTES</u>
(1) Install with long axis parallel to back of sidewalk.
(2) Install adjacent to back of curb.
(3) Remove and replace concrete sidewalk panel between nearest joint (approx. 5'x8').
(4) Stub 1.5" conduit one foot out of box toward east and cap.
(5) Stub 2" conduit one foot out of box toward SW and cap.
(6) Coil 30' of 5C in j-box for future connection to pedestrian head 68 and PPB 68 by others.
(7) Coil 15' of 5C in j-box for future connection to pedestrian head 69 and PPB 69 by others.

10. Signing -

Signs shall be shown on all mast arms. Signs that are post mounted but are signal related (such as a “signal ahead” sign) shall be shown on the Signal Plan. A sign display for each sign or table shall be shown on the plan with the MUTCD sign designation, dimensions, and legend for all signs. A detail of the City’s LED lighted street name sign with logo and street name shall be detailed either on the Signal Plan or on the detail sheet and referenced. All signs to be removed shall be shown with special instructions for the removal of existing stop signs that are being utilized at the intersection planned for signalization. Installation of “New Signal Ahead” or “Signal Revision Ahead” signs with Fluorescent flagging shall be shown with instructions that the signs timing and removal by the City after 30-days. It is acceptable to add the “New Signal Ahead” information and requirements to the technical specifications.

11. Other Illumination -

- Proposed illumination that is connected to the signal service cabinet, but is located outside the four quadrants of the intersection, shall be shown as proposed on a separate illumination plan sheet. On the signal plan sheet, the illumination shall be shown gray scale and labeled as “proposed illumination, see illumination plans”. However, once the illumination enters the quadrants of the intersection, it shall be shown as proposed on the signal plan and gray scale on the illumination plan.
- The streetlights on the signal poles shall be on one circuit. Other streetlights shall be on separate circuit(s).

D. Schematic Wiring Diagram

The City requires a field wire termination diagram for all poles and controllers. Items shown on the schematic wiring diagram shall include, but not be limited to the following:

- A schematic wiring diagram for each pole from the nearest junction box to each item located on the pole, including the terminal compartment, vehicle and pedestrian heads, push buttons, cameras, EVP detectors and lights, illuminated street name signs, luminaires, and any other electrical equipment mounted on the pole or mast arms.
- All termination points in the controller cabinet (cabinet diagram). The wiring diagram should include every termination point the controller will have, including those that may not be used for this particular signal design. This is required because the City will then have the option of interchanging the controller with another if needed in the future.
- Termination numbering, in conformance with the Field Wiring Chart in Section 8-20.3(8) of the Special Provisions, for each electrical item shown including the terminal compartment.
- All wire colors at each end of the wire.
- A call out to each wire run noting the number and type of each wire.
- Numbering for all items in conformance with the identification numbers shown on the plan sheet.
- Interconnect shall be shown on the wiring diagram.

E. Pole Schedule Sheet

The Pole Schedule Sheet shall conform to the following requirements:

- A Signal Standard Detail Chart in conformance with WSDOT requirements and Standard Details.
- Wind-load calculations shall assume 9.2 square feet of area for a 3-section signal head, 11.6 square feet for a 4-section signal head, 13.9 square feet for a 5-section signal head, and 14.4 square feet for a 5-lens cluster (dog-house) signal head.
- A Soils Report prepared and signed by a Geotechnical Engineer shall be included for each project to determine the lateral bearing pressure of the soil. A minimum of two borings shall be made in opposing corners of the intersection or elsewhere as required. Where the lateral bearing pressure is 1000 psf or above, the WSDOT Foundation Depth Table (Figure 850-13 of the WSDOT Design Manual) may be used to determine the foundation depth. Where the lateral bearing pressure is below 1000 psf, the foundation depth shall be determined by the Geotechnical Engineer.
- The Signal Standard Detail Chart shall show all orientations for attachment of mast and luminaire arms, base plates, and pole shaft mounted equipment.

F. Signing and Striping Plan

Include all information needed for striping layout and sign placement for post mounted signs. Sheet can be broken with match lines as needed. Striping should reflect all lane lines and pavement markings with station and offsets at key locations. It should also provide enough information to illustrate the revised striping that will tie into existing striping with conflicting markings planned for removal shown in lighter gray.

E. Detail Sheets

Provide project needed details on separate plans.

IV. DESIGN GUIDELINES

The following guidelines are to inform the Designer of the City's requirements for signal design.

A. Left-Turning Traffic

Left-turning traffic can be better accommodated when the opposing left-turn lanes are directly opposite each other. For every intersection, a turning analysis should be conducted using SU-30 as the design vehicle, using Autoturn software or equivalent. The analysis should show that opposing left-turning vehicles do not approach any closer than 10 feet from each other. For intersections that are anticipated to consistently encounter larger trucks, such as an intersection located close to a facility which uses large trucks, a larger design vehicle shall be used for the turning analysis. The analysis should be submitted to the City with the first submittal of the plans. Dual left turns will require the same analysis.

B. "T" Intersections

"T" intersections provide a good opportunity to apply the overlap phase methodology. Specifically, the left-turning traffic on the major leg and the right-turning traffic on the minor leg can run concurrently, if the turning traffic approaches have a turn-only lane. In addition, the pedestrian movement crossing the major leg can be added to the overlap phase if the crosswalk is not in conflict with the minor leg right-turning traffic. The engineering study should consider the use of overlap phasing in this situation by placing the crosswalk on the left-hand side of the intersection.

C. Crosswalks and Pedestrians

Pedestrian displays and push buttons are required at all signalized intersections unless the pedestrian movement is prohibited. Crosswalks should be located as close as possible to the intersection. Push buttons shall not be placed more than 5 feet from the normal path of the pedestrian and no more than 10 feet from the center point at the end of the associated crosswalk. Special consideration should be given to people with disabilities when locating the push buttons. When the push button is installed on a vehicle signal standard, a paved path of at least 4-feet wide from the shoulder or sidewalk to the standard shall be provided. If this is not possible, a pedestrian push button post shall be provided. If installed behind a guardrail, pedestrian push button posts should not be greater than 1.5 feet from the face of the guardrail.

D. Controller, Cabinet and Service Equipment

The signal controller shall be placed in an area such that a service vehicle could "hop" the curb and park adjacent to the controller. In addition, the controller should be placed so that an operator can see the traffic signal while accessing the controller. The door to the controller shall always open in the direction away from the intersection. The controller shall be placed in a location such that it should not require relocation if widening of the intersection happens in the future. The controller should always be located outside of the sight triangle lines for safe right-turn-on-red turning movements.

The service cabinet and UPS cabinet shall be installed on the same foundation as the controller cabinet per the Standard Detail.

E. Phase Numbering

Typically, phase numbering shall be in accordance with Figure IV-2. Phase 2 shall be assigned to the major movement in the eastbound or northbound direction. However, the City may request that the phase numbering be different from the standard in order to match existing phase numbering along a particular corridor. Therefore, the Signal Designer shall contact the City to confirm the signal phasing prior to the first submittal.

F. Preemption Location and Numbering

Emergency vehicle preemption detection with confirmation light shall be provided for all legs of the intersection. Typically, one preemption sensor is placed on each signal pole mast arm. However, the sensors should be placed in locations where they can detect emergency vehicles up to 800 feet away from the intersection. Where this cannot be achieved with the mast arm mounted detector, an advance unit mounted on a street light pole or Type 1 signal pole shall be provided.

- Preemption sensors are numbered EV-A for Phases 2 and 5, EV-B for Phases 4 and 7, EV-C for Phases 1 and 6, and EV-D for Phases 3 and 8.

G. Signal and Pedestrian Heads

1. Signal Head Location and Size -

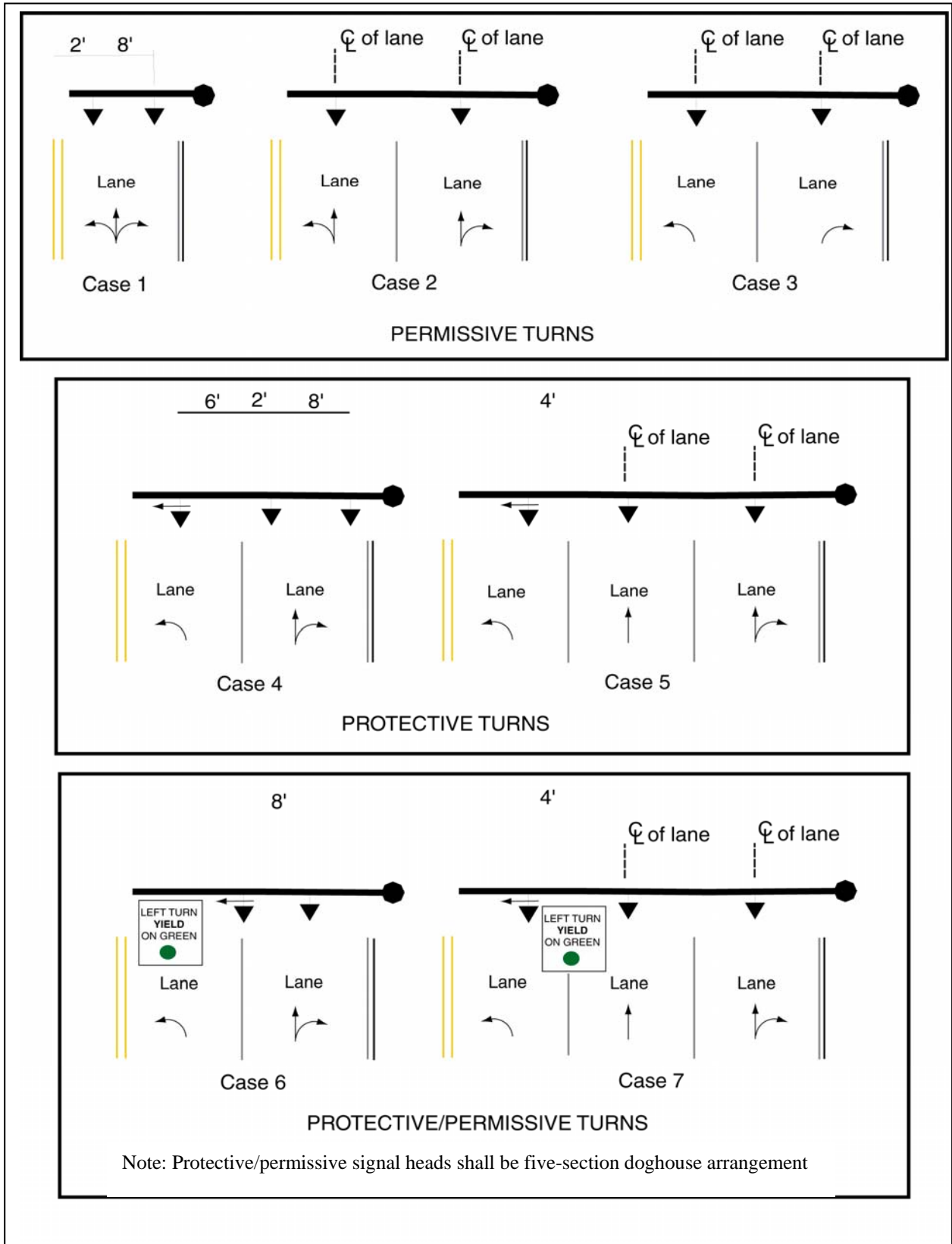
- Signal head location shall be in accordance with the MUTCD. For various signal head combinations, refer to Figure IV-1, Typical Traffic Signal Head Alignments.
- Only Type M mounting of signal heads on the mast arms is allowed. The mounting is connected to the signal head between the red and yellow signal faces.

2. Signal Head Numbering -

Signal head numbering shall be identified with a two-digit number. The first digit shall correspond with the phase number and the second digit shall correspond with the lane number. The second number - 1 will be the lane furthest from the curb. (Reference Figure IV-2 below)

- For left-turn signal heads with protective/permissive phasing, the signal head shall have a two-digit number for each phase. For example, a five-section signal head has a green display for both Phases 4 and 7, and if the signal head is on the mast arm and furthest from the pole, the signal head number shall be 41/71.
- For signal heads that are part of an overlap phase (e.g. phases that do not normally run concurrently) including protective/permissive right-turn signal heads, the signal head number shall be the overlap "letter" and a number. For example, if a signal head has a green display during the Overlap A phase, which is defined to be green during Phases 4 of 5, the signal head number shall be A1.

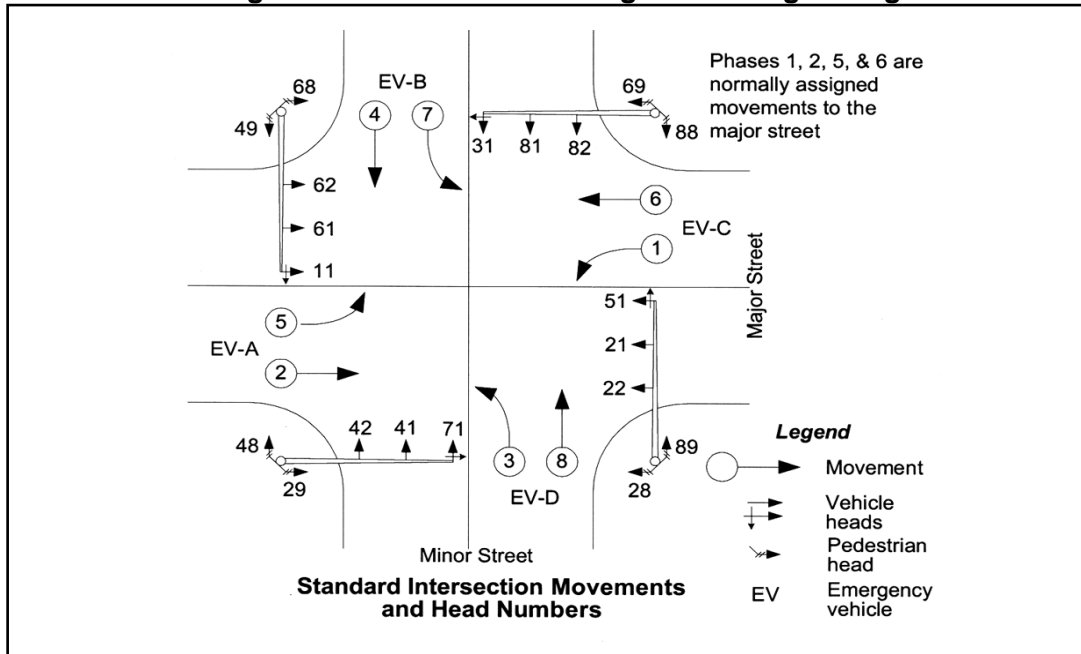
Figure IV-1. Typical Traffic Signal Head Alignments



3. Pedestrian Head Location and Numbering -

- A pedestrian head shall be provided at each end of every signalized crosswalk at the intersection. Pedestrian head location shall be in accordance with the MUTCD.
- Type E mounting shall be used.
- See Figure IV-1 below for pedestrian head numbering.
- The terminal cabinet shall be placed at 10-feet from the finished grade for retro signal systems and for new projects, a terminal compartment integral with the pole shall be provided per the Special Provisions to the pole with the bottom of door placed five feet up from the finished grade.

Figure IV-2. Standard Phasing Numbering for Signal Heads



H. Detection Camera Location and Numbering

Normally, detection cameras shall be located on the vehicle signal mast arm or on the luminaire mast arm.

I. Signal Poles

- Whenever possible, signal poles shall be placed no closer than 4.5 feet from the face of the curb. For locations that do not have a sidewalk, the WSDOT requirements for clear zone distance shall apply (see Figure 700-1 of the WSDOT Design Manual).
- If possible, signal poles shall be placed in a location such that they should not require relocation if widening of the intersection happens in the future.
- Pot-holing for utility conflicts is required prior to approval of the signal plans and should be conducted between the first and second submittal.
- Every signal pole shall have a luminaire. Where this is not possible due to the presence of overhead power lines, the pole shall be designed as a Type 3 pole and the pole shaft shall have a removable cap installed above the signal mast arm attachment point. Additional luminaire poles

may be required to provide adequate illumination at the intersection. This shall be discussed with the City prior to design. The luminaire arm should be long enough so that the luminaire extends over the curb. See City Standard Details for additional information and luminaire type.

- Pedestrian push button locations shall meet WSDOT design standards Figure 850-8a – 850-8b and as described under IV. C. Crosswalk and Pedestrians of this Manual.

J. Power Source

1. The location of the power source shall be identified on the plans. If possible, the location should be in the same corner as the service cabinet. The power source shall be 120/240-volt single phase.
2. It is the responsibility of the Designer to contact the power company to determine the power location and provide connection instructions on the plans prior to third submittal. The signal design shall include enough cable and conduit for the Contractor to bring the power cable to the power source and leave enough left over for the utility company for hook-up.

K. Interconnect

1. The Signal Designer shall contact the City to identify unless otherwise approved by the City. If interconnect is included, it shall be identified on the signal plan wiring schedule to the point to the limit of the signal improvement.

L. Conduit

1. The City uses galvanized rigid steel, schedule 80 PVC, and schedule 40 PVC conduits. See section 8-20.3(5) of the City Special Provisions for uses in different areas.
2. Conduit Size:
 - Conduit diameter sizes shall be 1-1/4 minimum and 4 inches maximum with the exception for 1/2 inch conduit for the service grounding electrode conductor. Conduit size is based on total area of cable enclosed in the conduit and shall be determined by Tables IV-2 and IV-3. See City of Puyallup Special Provisions for cable and conduit type.

Table IV-1. Signal Conductor Sizing Table

Cable	Area (inch²)	Use of Cable
#8	0.060	Illumination/Ground
#4	0.109	Controller-Service
#2	0.147	Service-Power Source
2cs-#14	0.090	Detection Loop
3cs-#20	0.070	Preemption
5c-#14	0.140	Vehicle/Pedestrian Heads
6pcc-#19	0.320	Interconnect

NOTE:

- c = conductor
- cs = conductor shielded
- pcc = pair communications cable

Table IV-2. Conduit Fill Area

Size (in)	Max Cable Fill – New Conduit 26% (inch²)	Max Cable Fill – Existing Conduit 40% (inch²)
1.25	0.40	0.61
1.5	0.54	0.83
2	0.89	1.36
2.5	1.27	1.95
3	1.95	3.00
3.5	2.60	4.00
4	3.35	5.15

3. In addition to the requirements for illumination wires, signal wires shall be installed in two separate conduit systems. Field wiring for the pedestrian push buttons, EVP detectors, video detection cameras, PTZ cameras, broadband antenna, and interconnect shall be installed in one conduit. Field wires for the pedestrian signal heads, vehicle signal heads, and the EVP confirmation lights shall be installed in another conduit system. Joint junction boxes shall be used.
4. Spares
A spare 2-inch conduit shall be provided in every street crossing, and a spare 3-inch conduit shall be provided between the controller and adjacent junction box(es). A spare 2-inch conduit shall be provided between each signal pole and its adjacent junction box.
5. Conduits Containing Illumination Wires
Field wires for illumination circuits and for the illuminated street name signs shall be installed in a separate conduit system utilizing separate conduit and junction boxes.

M. Wires

1. Signal heads shall only use 5-conductor cables. Between the signal head and the terminal cabinet on the pole, each signal head shall have its own 5-conductor cable. Two 5-conductor cables shall service protective/permissive signal heads. Between the terminal cabinet and the controller, one 5-conductor cable can service a maximum of three signal heads sharing the same phase.
2. At locations where protected or protected/permissive left turn phases are anticipated in the future, a spare 5C cable shall be installed between the controller and the terminal compartment on the pole shaft. The 5-conductor cable shall be landed in the pole terminal compartment, and labeled per the future left turn phase. The 5-conductor cable shall not be landed in the controller.
3. One 5-conductor cable shall serve each pedestrian head and a 2-conductor shielded cable shall serve the associated pedestrian push button.
4. One 2-conductor shielded cable shall serve each pedestrian push button on a stand-alone pushbutton post.
5. One 3-conductor shielded cable shall serve each preemption detector. No splices shall be allowed for 3-conductor shielded cables between the detector and the controller.
6. One 2C cable shall serve each EVP confirmation light.
7. One 5C co-axial cable shall serve each detection camera.
8. One 2C cable shall serve each illuminated street name sign.
9. Three #8 insulated wires shall service the illumination on the signal poles.
10. Typically, interconnect cables are 6-pair #19 AWG wires or 6-strand single mode fiber optic cable.
11. Three #4 insulated wires shall connect the controller to the service cabinet.

12. Three insulated wires shall connect the service cabinet to the power source. Wires shall be sized to accommodate the main breaker size in the service cabinet per National Electric Code requirements for amperage and voltage drop. The wires shall be located in a separate conduit run and, if applicable, junction box with locking lid.
13. One #10 AWG grounding wire is required per conduit carrying greater than 50 volts.

N. Wire Termination Numbering and Colors

Please refer to Tables IV-4, IV-5, and IV-6 for the standard termination numbering and wire color for vehicle heads, pedestrian heads, and preemption detectors.

Table IV-3. Signal Heads Termination Numbering and Wire Color

Termination Number	Wire Color	Color Code	Use
6*1	Red	R	Red
6*2	Orange	O	Yellow
6*3	Green	G	Green
6*6	White	W	Neutral
6*7	Black	B	Spare

NOTE: *corresponds with the phase number.

Table IV-4. Pedestrian Heads/Push Buttons Termination Numbering and Wire Color

Termination Number	Wire Color	Color Code	Use
7*1	Red	R	Red
7*2	Orange	O	Yellow
7*3	Green	G	Green
7*6	White	W	Neutral
7*7	Black	B	Spare

Table IV-5. Preemption Detection Termination Numbering and Wire Color

Termination Number	Wire Color	Color Code
5*1	Orange	O
5*2	White	W
5*3	Blue	BL

NOTE: *corresponds with the phase number. For preemption, 1 is used for Phases 1 and 6, 2 is for Phases 2 and 5, 3 is for Phases 3 and 8, and 4 is for Phases 4 and 7.

O. Junction Boxes

Junction boxes shall be placed and sized using the following criteria:

1. Adjacent to signal poles.
2. Adjacent to controller.
3. At each end of every conduit street crossing.
4. Junction boxes shall be placed as far away from the back of curb as possible to provide safe access for the City maintenance staff.

5. If possible, the junction box shall be placed behind the sidewalk to avoid the possibility of pedestrians slipping on the junction box during rainy or frosty days.
6. Junction boxes shall be placed such that no conduit run shall be greater than 200 lineal feet.
7. Junction boxes shall be placed outside of wheelchair ramps.
8. Junction boxes shall be placed every time a conduit run has to turn 90 degrees horizontal or greater.
9. Junction boxes shall be sized according to WSDOT Standard Plan J-11a. A Type 2 or greater junction box is required for all junction boxes containing interconnect wires.
10. Large junction boxes shall be Type 7 with dual lids.
11. For junction boxes located in landscape areas on a steep slope, where overgrowth or the slope may make it difficult to open the junction box lid, the junction box shall have a dual-hinged lid.
12. Junction boxes containing illumination wire shall have the letters “**LT**” inscribed on the lid.
13. Junction boxes carrying the wire between the service cabinet and the power source shall have a locking lid and shall not contain any other wires.
14. All junction boxes carrying signal equipment and/or interconnect shall have the letters “**TS**” inscribed on the lid. All junction boxes carrying only interconnect equipment shall have the letters “**INTC**” inscribed on the lid.

P. Signing

1. Determination of sign placement shall be in accordance with the MUTCD.
2. Each signal pole mast arm shall have one LED lighted street name sign. Typically, the street name signs shall be located between signal vertical standard and the nearest signal head. See Puyallup Standard Drawings for street name sign specifications.

V. DIVISION 8

Consultant to fill in yellow highlighted areas and to confirm detail number is current.

DIVISION 8

MISCELLANEOUS CONSTRUCTION

8-20 ILLUMINATION, TRAFFIC SIGNAL SYSTEMS, AND ELECTRICAL

8-20.1 Description SUPPLEMENT

The work to be performed shall consist of the installation of a complete and operable traffic signal and illumination system at the intersection of **(LOCATION)** in the City of Puyallup.

Work at this intersection shall include furnishing and installation of fully equipped UPS cabinet, controller cabinet, service cabinet, and a fully functional traffic signal system including traffic signal and pedestrian poles, vehicle and pedestrian signal heads, pedestrian push buttons, luminaries, emergency vehicle detectors and confirmation lights, video detection cameras, junction boxes, conduits, conductors, and other incidental materials as may be required to comply with the Plans and these Specifications. **(FOR CIP PROJECTS, THIS LIST MAY BE REVISED IF THE CITY IS PROVIDING THE SIGNAL EQUIPMENT).**

8-20.1(1) Regulations and Codes MODIFICATION

All electrical equipment shall conform to the Standards of the National Electrical Manufacturer's Association (NEMA). In addition to the requirements of these Specifications, all materials and methods required under this section, unless otherwise superseded herein, shall conform to the **latest edition of the Washington State Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction*** (herein referred to as **Standard Specifications**); to all current amendments to the **Standard Specifications**; to the **latest edition of the Washington State Department of Transportation *Standard Plans for Road, Bridge, and Municipal Construction*** (herein referred to as the **Standard Plans**); to the **State of Washington Signal Fabrication Manual**; the **American Standards Association (ASA)**; **American National Standards Institute (ANSI)**; to the **City of Puyallup Standards for Public Works Engineering and Construction Manual**; to the current **National Electric Code (NEC)**, Laws, Rules & Regulations for Installing Electrical Wires & Equipment, of the **Department of Labor and Industries**, State of Washington; and to the current **Manual on Uniform Traffic Control Devices (MUTCD)** as adopted by the State of Washington.

All requirements of the Washington State Department of Labor and Industries shall be incorporated into the project. It shall be the Contractor's responsibility to determine these requirements and to coordinate all inspections by the Department of Labor and Industries.

Safe wiring labels required by the Department of Labor and Industries will be required for this project.

Prior to start of work, all necessary licenses, permits, and approvals shall be obtained. The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the work, the protection of adjacent property, and the maintenance of all other facilities. The Contractor will be required to comply with all the provisions of these instruments and shall save and hold the City of Puyallup harmless from any damage which may be incurred as a result of the Contractor's failure to comply with all the terms of these permits.

8-20.1(3) Restrictions on the Schedule of Work

NEW

A. Mast Arm Erection

Mast arms should not be erected more than 14 calendar days prior to the signal system being turned on. Vertical signal poles may be installed earlier with no limiting days prior to signal being placed into operation.

B. Signal Head Installation

The vehicle and pedestrian signal heads and push buttons shall be covered immediately upon installation and shall remain covered until the signal is turned on. A small hole shall be created in the cover that aligns with each signal lens or pedestrian legend for the purpose of final field testing.

C. Work in Roadway

The roadway shall be kept open to traffic at all times, except when specific tasks required by this Contract require construction in the roadway. All work within the traveled way of any roadway shall be limited to the hours between 9:00 a.m. to 3:00 p.m., unless otherwise approved by the City Traffic Engineer. Work shall be accomplished such that at least one lane of traffic is open in each direction on every leg during working hours, except for mast arm erection. Exceptions to this will require a 3-day advance approval from the City Traffic Engineer.

D. Traffic Control During Construction

The Contractor shall submit a detailed traffic control plan and obtain approval from the City Traffic Engineer prior to roadway trenching, erection of mast arms, and other activities requiring lane closures or detours. During traffic interruptions, qualified flag persons will control traffic unless otherwise specified.

During the erection of mast-arm assemblies, the Contractor, with the authorization of the City Traffic Engineer, may block all traffic lanes for a maximum of 5 minutes at a time between 9 and 11 a.m. on any day of the week. Work performed on Saturday, Sunday, or holidays require the presence of a City inspector.

Unless otherwise approved by the City Traffic Engineer, the Contractor shall furnish an off-duty police officer for traffic control during all roadway work performed at night, for all roadway work performed within 150 feet of an intersection, and for all other conditions where the City Traffic Engineer deems it necessary for safety. The off-duty police officer shall be in addition to all other personnel required for flagging.

E. Permits

The Contractor will be responsible for coordinating, obtaining, and paying for all permits necessary to complete this work in a timely fashion. An electrical permit shall be obtained before beginning trench excavation. If the signal construction is a City project, all City permits will be provided by the City on the day of the pre-construction meeting at no fee to the Contractor.

**8-20.1(4) Special Provisions Included in Contract Price
(CIP PROJECTS ONLY)**

NEW

All costs incurred by reason of, or in connection with, the Special Provisions shall be included in the contract bid price.

8-20.1(5) Errors and Omissions

NEW

The Contractor shall immediately notify the City Traffic Engineer or the assigned City Inspector upon discovery of any errors or omissions in the Contract Documents, in the layout as given by survey points and instructions, or of any discrepancy between the Contract Documents and the physical conditions of the locality. If deemed necessary, the City Traffic Engineer or the assigned City Inspector shall rectify the matter and advise the Contractor accordingly. Any work done after such discovery without authorization by the City Traffic Engineer or the assigned City Inspector will be done at the Contractor's risk.

8-20.1(6) Warranties

NEW

The Contractor shall provide a warranty for all material to be furnished under this Bid for a period of one year, unless otherwise specified, from the date of actual turn-on. The warranty shall apply to all material including those items not manufactured by the Contractor.

The warranty shall provide that all material at the time of delivery shall be free from defects in material and workmanship and shall be fit for the use set forth in these Specifications.

The warranty shall assign responsibility to the Contractor for all costs of replacement or repair of defective materials except those materials supplied by the City. Replacement of repair shall be made within 5 working days following notification of a discrepancy.

The controller cabinet and all of its contents shall carry a 10-year limited warranty. This limited warranty must be protected in the event the manufacturer(s) is no longer able to honor a claim. The limited "warranty protection" must come from an insurance company approved by the Washington State Insurance Commissioner. The limited warranty shall be written on a declaration document and acknowledged by an authorized agency. The warranty exclusions, terms, and conditions shall be in writing and approved by the City of Puyallup prior to turn-on of the traffic signal system.

8-20.2 Materials

SUPPLEMENT

All materials necessary for the completion of the project shall be furnished by the Contractor except as specifically noted to be furnished by the City. Work shall include furnishing all materials, except those to be furnished by the City as noted in Section 8-20.1 of the Special Provisions, and for installing all materials including transporting City furnished materials to the project site.

The City Traffic Engineer or the assigned City Inspector reserves the right to inspect the manufacturing process of all materials. Final inspection and acceptance of the installed materials will not be given until final installation and testing has been completed on the systems. Approval to install materials and equipment must be obtained from the City Traffic Engineer or the assigned City Inspector at the job site before installation.

8-20.2(1) Equipment List and Drawings

SUPPLEMENT

The Contractor shall submit three (3) copies of a complete list of all materials and equipment proposed to be furnished and installed. Such submittals may be in the form of shop drawings, catalog cut sheets, or product specifications as appropriate to allow the City Traffic Engineer to determine compliance with the Plans and Specifications. Such materials shall include but not be limited to the following:

Wire, quick disconnect kits, conduit, junction boxes, signal heads, pedestrian heads, luminaires, video detection cameras, push buttons, internally illuminated signs, emergency preemption equipment, and other appurtenances.

Three (3) sets of complete shop drawings and product data shall be furnished for the following:

Service cabinet and internal components, controller cabinet and internal components, UPS cabinet and internal components, and signal poles.

Approval of shop drawings for signal work may require up to thirty (30) calendar days from the date the City Traffic Engineer receives the drawings until they are returned to the Contractor. The actual time required for approval is dependent upon the completeness and appropriateness of the drawings as submitted.

Any deficiencies will require additional time for approval based on the degree of the deficiency and the additional review time required. If the shop drawings are returned to the Contractor to correct any deficiencies, an additional 14 calendar days may be required for the approval process.

If more than 30 calendar days are required for routine approval of shop drawings that are completed and accurate, the Contractor will be granted an extension of time equal to the additional review time. Materials not approved by the City Traffic Engineer will not be permitted on the job site.

8-20.3 CONSTRUCTION REQUIREMENTS

8-20.3(1) General

Product Handling

NEW

All equipment shall be handled and protected in such a way to prevent damage. Damaged equipment, if any, shall be repaired or replaced by the Contractor to the satisfaction of the City Traffic Engineer or the assigned Signal Technician at no additional cost to the City.

Existing Conditions

NEW

No new fixtures shall be constructed as part of this contract that is in conflict with any existing utilities, or the code required thereby. It shall be the Contractor's responsibility to locate all utilities whether above, on, or below the ground and to protect against any and all damages arising from work under this project. At least 48 hours before digging, the Contractor shall call the Utilities Underground Locator Center (telephone 811 or 1-800-424-5555).

Existing underground utilities are indicated on the Plans in their approximate location from field markings by the respective utility companies without uncovering. Such indication does not relieve the Contractor, however, from the responsibilities indicated herein.

In case of damage to any utilities above, on or below ground, the Contractor shall immediately notify the utility agency involved.

Power, telephone, and gas facilities shall be repaired by the respective utility company. Prior to start of construction, the Contractor shall contact any remaining utilities to obtain material requirements and determine repair procedures. Such repairs may be the responsibility of the Contractor as directed by the respective utility.

The Contractor shall be responsible for the costs to repair any utilities damaged by the Contractor regardless of whether the utility company or the Contractor repairs the utility.

The Contractor warrants and represents that it is fully aware of the statutory provisions contained in RCW 19.122.010 through .900, that it has read and fully understands the same, and that it will comply with the requirements of these provisions which are incorporated by reference herein. The Contractor agrees that all trenching as well as excavating for mast arm pole bases shall be an "excavation" as defined under RCW Chapter 19.122 and that such utilities constitute underground facilities. The parties agree that remedies affected under RCW Chapter 19.122 are also incorporated by reference herein. Any cost to the Contractor as a result of this law shall be at the Contractor's expense.

Existing Signal Operation During Construction

See Section 1-07.23 of these Special Provisions for operation of existing signal systems during construction of the new signal systems at the same location.

8-20.3(2) Excavating and Backfilling

MODIFICATION

Excavating and backfilling shall be performed in accordance with Section 8-20.3(2) of the Standard Specifications except as modified herein:

8-20.3(2)A Trench and Backfill New Section

The Contractor shall provide trenching as specified herein, regardless of the material encountered, as necessary for complete and proper installation of the signal, illumination, and interconnect conduit. Trenching shall conform to the following:

PAVEMENT AND SIDEWALK REMOVAL

Where trenches are located in paved areas that are not to be replaced as part of this project, the pavement shall be removed by saw cut. The saw cuts shall be a minimum of 2 inches deep and shall be parallel and as straight as possible. Slurry from the cutting shall be vacuumed up and properly disposed of as saw cutting is proceeding. Slurry shall not be allowed to run into drains or off-site.

After saw cutting, the pavement shall be removed in a manner that does not damage the adjacent pavement to remain.

Where trenches are located in sidewalk areas that are not to be replaced as part of this project, the sidewalk shall be removed and replaced to the nearest construction joint.

TRENCH EXCAVATION

Trench width shall be 4 inches or the sum of the conduit diameters plus 2 inches, whichever is greater. Trench width shall, however, not be greater than specified above.

Trench depth shall be sufficient to provide 18 inches of cover over the topmost conduit when outside of the roadway area and 24 inches of cover over the topmost conduit when below the roadway, driveways, or shoulder.

The trench bottom shall be graded to provide a uniform depth as specified above.

Material from trench excavation shall not be reused in trenches under the roadway, driveway, or shoulder. Unless the City Traffic Engineer or the assigned City Inspector directs such material to be used elsewhere, it shall be removed from the site and disposed of at a legal disposal site.

INSPECTION

All trenches shall be inspected by the City Traffic Engineer or the assigned City Inspector and by Labor and Industries (if necessary) prior to any backfill operations.

TRENCH BACKFILL

All trench backfill under roadways, driveways, or shoulders shall consist of crushed surfacing top course. All backfill shall be compacted with a power operated mechanical tamper per Method C. Trench backfill under areas outside of the roadway, driveway, or shoulder may be select material from the excavation if approved by the City Traffic Engineer or the assigned City Inspector. Otherwise, crushed surfacing top course shall be used.

RESTORATION

Asphalt concrete pavement thickness in paved areas that are not to be replaced as part of this project shall be 3 inches or match existing, whichever is greater.

8-20.3(2)B Directional Boring New Section

All conduits beneath the railroad tracks shall be installed by directional boring using a surface launched steerable drilling tool. Drilling shall be accomplished using a high-pressure fluid jet tool head. The drilling fluid shall be used to maintain the stability of the tunnel, reduce drag on the conduit, and provide backfill between the conduit and tunnel. A guidance system, which measures the depth, lateral position, and roll, shall be used to guide the tool head when creating the pilot hole. Once the pilot hole is established, a reamer and swivel shall be used to install the conduit. Reaming diameter shall not exceed 1.5 times the diameter of the conduit being installed. Conduit, which is being pulled into the tunnel, shall be protected and supported so that it moves freely and is not damaged during installation. The pullback force on the conduit shall be controlled to prevent damage to the conduit. A vacuum spoils extraction system shall be used to remove any excess spoils generated during the installation. Excess drilling fluid and spoils shall be disposed of. The method and location used for disposal of excess drilling fluid and spoils shall be subject to the City Traffic Engineer or the assigned City Inspector's approval. Drilling fluid returns (caused by fracturing of formation) at locations other than the entry and exit points shall be minimized. Any drilling fluid that surfaces through fracturing shall be cleaned up immediately. Mobile spoils removal equipment capable of quickly removing spoils from entry or exit pits and areas with returns caused by fracturing shall be used as necessary during drilling operations.

8-20.3(3) Removing and Replacing Improvements

SUPPLEMENT

Unless otherwise noted on the Plans, the Contractor shall protect salvage items from damage and shall deliver these items immediately upon their removal to the City's Corporate Yard (located at 1100 39th Avenue SE, Puyallup). Any existing equipment and material for salvage that is damaged during removal

or delivery shall be compensated for by the Contractor to the satisfaction of the City. All material from the existing signal system that will not be reused or salvaged will become the property of the Contractor and shall be removed from the Project.

All existing wires from terminated circuits shall be removed from the conduit system after completion of the new signal system.

The Contractor shall remove all nonessential junction boxes. The Contractor shall remove all foundations that are not to be reused to a depth of at least 3 feet below the existing or finished grade, whichever is lower, or removed entirely, unless otherwise noted on the Plans. The conduits connecting to the foundation shall be cut off and capped or removed as designated by the City Traffic Engineer or the assigned City Inspector. Any such foundation or conduit left below the surface shall be noted on the record drawings provided to the City by the Contractor.

The Contractor shall be responsible for disposing of all other waste created by the required salvage and removal of items shown on the Plans or specified herein.

8-20.3(4) Foundations

MODIFICATION

A. General Requirements

The Contractor shall provide all material for and construct the foundations for traffic signal poles, traffic signal controller, and service cabinet to the dimensions specified in the Contract Plans.

All material removed for the construction of foundations shall be removed from the project site at the Contractor's expense.

Concrete foundations shall be placed against undisturbed earth if possible. CDF shall be used to backfill around signal pole foundations that are not placed against undisturbed earth. Before placing the concrete, the Contractor shall block out around any other underground utilities that lie in the excavated base so that the concrete will not adhere to the utility line. The Contractor shall secure the anchor bolts required for the item to be mounted on the foundation. The Contractor shall also securely locate all conduit required, including a spare 2-inch conduit and a 1-inch conduit (slip base foundations only), to be used to connect the pole or controller cabinet ground wire to the ground rod in the nearest junction box. Concrete foundations shall be troweled, brushed, edged and finished in a workmanship-like manner. Concrete shall be promptly cleaned from the exposed portion of the anchor bolts and conduit after placement. Concrete and steel rebar shall be furnished and placed as shown in the Contract Plans. Concrete Class 3000 shall be used for all foundations.

After a curing period of 2 weeks, the Contractor may install the traffic signal poles, controller cabinet, and service cabinet on the new foundations.

Where foundations for the mast arm signal and street light poles are located within the new sidewalk area, each foundation shall be constructed in a single pour to the bottom of the new sidewalk elevation. The sidewalk shall be constructed in a separate pour. Where no sidewalk is present, the foundation elevation shall be set in the field by the assigned City Inspector.

The foundation for the controller cabinet, service cabinet, and UPS cabinet shall be constructed per City of Puyallup Standard Drawings.

Foundations for the signal standards shall be per the Pole Schedule plan sheet.

Foundations for Type 1 signal poles and Pedestrian Push Button Posts shall conform to WSDOT Standard Plan J-7a.

Street light pole foundations shall conform to WSDOT Standard Plan J-28.30-00 to the depths listed on the Luminaire Pole Schedule or the Pole Schedule Sheet.

Location of all concrete foundations shall be approved by the City Traffic Engineer or the assigned Signal Technician prior to excavation.

8-20.3(5) Conduit

MODIFICATION

Conduit installation shall conform to Section 8-20.3(5) of the Standard Specifications except as supplemented or modified by these Special Provisions.

Hot dip galvanized rigid steel conduit shall be used at the following locations:

- Between the service point and the service cabinet
- All conduit installed above ground, except on the service pole per the PSE installation detail.
- Between the service cabinet and the controller cabinet
- When installed by directional boring, regardless of function

Schedule 80 rigid PVC conduit shall be used at the following locations:

- All conduit, regardless of function, installed under areas of traffic including roadways, shoulders, and driveways
- All conduit containing signal wires, regardless of location, except where galvanized rigid metal is specified
- All other locations except as noted below

Schedule 40 rigid PVC conduit may be used at locations other than as noted above for Schedule 80 PVC and galvanized steel Schedule 40 polyvinyl chloride (PVC) conduit may be used at all other locations. Aluminum conduit shall not be used. All conduits shall be consistent with the requirements of Section 9-29.1 of the Standard Specifications.

The Contractor shall provide and install all conduit and necessary fittings at the locations noted on the Plans. Conduit size shall be as indicated on the signal-wiring schedule. If the Contractor elects to use larger conduit without reasonable justification, the Contractor will be responsible for any increase in cost due to other changes required.

When interconnect cable is part of a project, the conduit sweeps bringing the interconnect cable into and out of the junction boxes shall be offset as directed by the City Traffic Engineer to accommodate the cable's tendency to curl. The conduit sweep shall have a minimum bend radius of 36 inches.

Conduits entering through the cabinet foundation shall be arranged for maximum accessibility as directed by the City Traffic Engineer.

Conduits shall be capped during construction using manufactured seals to prevent entrance of water and debris. The conduits shall be cleaned before pulling wire. Spare conduits shall include a bull-line tape. Spare conduits shall be capped and labeled as City of Puyallup conduits.

Each conduit entering the junction boxes shall be neatly upswept and shall terminate not less than 6 inches nor more than 8 inches below the lid of the junction box. The location of the conduit within the junction box shall be such that the side of the junction box through which the conduit enters shall indicate from which direction the conduit came.

All conduit installed underground shall have polyethylene Underground Hazard Marking Tape, 6 inches wide, red, legend "Caution-Electric Line Buried Below," placed approximately 12 inches above the conduit.

8-20.3(6) Junction Boxes

SUPPLEMENT

The Contractor shall supply all junction boxes. The locations of the junction boxes are noted on the Plans by station and offset from construction centerline. The location of junction boxes in the new sidewalk areas may be adjusted and the boxes oriented to be within the sidewalk that is not within the area of wheelchair ramps, landings, and driveways. The new junction box shall not interfere with any other previous or relocated installation. Junction boxes shall not be placed in the travel way. The lid of the junction box shall be flush with its frame and with the surrounding area whether it is shoulder, sidewalks, or other surface. Placement of junction boxes shall also conform to the plans and details of this contract. Junction boxes shall be installed on 6 inches of compacted crushed surfacing top course and a brick shall be placed under each corner to prevent settling.

When included in the Contract Plans, junction box spacing for interconnect cable shall be 1 at every intersection or a maximum of 300 feet apart, whichever is less. Type 2 junction boxes shall be used.

All junction box lids shall be grounded in a manner that will allow removal of the lid without breaking the ground.

8-20.3(8) Wiring

MODIFICATION

Installation shall conform to the requirements of Section 8-20.3(8) of the Standard Specifications and as modified herein:

A. General

All wires terminated at a terminal block shall have an open end, crimp style solderless, insulated terminal. All terminals shall be installed with a tool designed for the installation of this type of terminal. Crimping with pliers, wire cutters, etc., will not be allowed. Terminals shall be color coded to the wire and sized to fit snugly on wire ends. No exposed conductor will be allowed. All wiring inside the controller cabinet and at intermediate points shall be trimmed and cabled together to make a neat and clean-appearing installation. No splicing of any traffic signal conductor shall be permitted unless otherwise indicated on the Plans. All conductor runs shall be pulled to the appropriate signal terminal compartment board with pressure type binding posts. The only exceptions shall be the splices for detector loops at the nearest junction box to the loops and splices in illumination circuits.

Each end of every conductor at each wire termination, splice, connector, or device shall have a PVC wire marking sleeve bearing as its legend the circuit number indicated in the wiring schedule. Where terminal strips are used as a connecting device between conductors, the terminal strips shall also bear the circuit numbers. All illumination circuits shall be labeled with a PVC marking sleeve bearing the circuit number at each junction box whether splices

are present or not. Terminal strips in cabinets, or when used as a connection device between conductors, shall bear the circuit numbers.

The un-fused service wires between the Puget Sound Energy transformer and the service cabinet shall be labeled "Un-fused Service" at all terminal ends.

The Contractor shall provide to the City of Puyallup a red-line print of the wiring diagram showing as-built information of the field wiring prior to acceptance of the project by the City.

B. Interconnect Cable

The Contractor shall provide and install a copper 6-pair shielded interconnect cable and a 6-strand single-mode fiber optic cable in designated conduits as shown on the Plans. The shielded copper interconnect cable shall be terminated on a terminal strip within a designated controller cabinet or in a designated terminal cabinet. The Contractor shall terminate the fiber strands of the interconnect cable into a telemetry module within a designated controller cabinet or in a designated terminal cabinet.

Field Wiring Chart
(March 13, 1995)

	AC+ Input				AC- Input				516-520 Railroad Pre-empt				
	Control-Display				5A1-5D5 Emergency Pre-empt				541-580 Coordination				
	Sign Lights				581-599 Spare								
Movement Number	1	2	3	4	5	6	7	8	9				
<u>Vehicle Head</u>													
Red			611	621	631	641	651	661	671	681	691		
Yellow			612	622	632	642	652	662	672	682	692		
Green			613	623	633	643	653	663	673	683	693		
Spare			614	624	634	644	654	664	674	684	694		
Spare			615	625	635	645	655	665	675	685	695		
AC-			616	626	636	646	656	666	676	686	696		
Red Auxiliary			617	627	637	647	657	667	677	687	697		
Yellow Auxiliary			618	628	638	648	658	668	678	688	698		
Green Auxiliary			619	629	639	649	659	669	679	689	699		
<u>Pedestrian Heads & Dets.</u>													
Hand			711	721	731	741	751	761	771	781	791		
Man			712	722	732	742	752	762	772	782	792		
AC-			713	723	733	743	753	763	773	783	793		
Detection			714	724	734	744	754	764	774	784	794		
Common-Detection			715	725	735	745	755	765	775	785	795		
Spare			716	726	736	746	756	766	776	786	796		
Spare			717	727	737	747	757	767	777	787	797		
Spare			718	728	738	748	758	768	778	788	798		
Spare			719	729	739	749	759	769	779	789	799		
<u>Detection</u>													
AC+			811	821	831	841	851	861	871	881	891		
AC-			812	822	832	842	852	862	872	882	892		
Common-Detection			813	823	833	843	853	863	873	883	893		
Detection A			814	824	834	844	854	864	874	884	894		
Detection B			815	825	835	845	855	865	875	885	895		
Loop 1 Out			816	826	836	846	856	866	876	886	896		
Loop 1 In			817	827	837	847	857	867	877	887	897		
Loop 2 Out			818	828	838	848	858	868	878	888	898		
Loop 2 In			819	829	839	849	859	869	879	889	899		
<u>Supplemental Detection</u>													
Loop 3 Out			911	921	931	941	951	961	971	981	991		
Loop 3 In			912	922	932	942	952	962	972	982	992		
Loop 4 Out			913	923	933	943	953	963	973	983	993		
Loop 4 In			914	924	934	944	954	964	974	984	994		
Loop 5 Out			915	925	935	945	955	965	975	985	995		
Loop 5 In			916	926	936	946	956	966	976	986	996		
Loop 6 Out			917	927	937	947	957	967	977	987	997		
Loop 6 In			918	928	938	948	958	968	978	988	998		
Spare			919	929	939	949	959	969	979	989	999		

8-20.3(10) Service

MODIFICATION

Power sources shown in the Plans are approximate only; exact location will be determined in the field. The Contractor shall contact PSE (or the appropriate service provider) prior to installation to ascertain any installation and material requirements, particularly in relation to the meter and enclosure.

The service cabinet with the breakers shall be mounted adjacent to the controller cabinet.

The Contractor shall have the service inspected by the Department of Labor & Industries and shall be solely responsible for coordination with the power company to have the service energized. The City will aid in this process at the request of the Contractor.

8-20.3(11) Field Test

SUPPLEMENT

Intersection Turn-On Procedure

Prior to scheduling a Turn-On date, the Contractor shall verify with the assigned City Inspector that:

1. Field tests 1, 2, and 3 as specified in Section 8-20.3(11) have been completed.
2. All other field tests specified in Section 8-20.3(14)D have been completed.

In addition, "New Signal Ahead" signs (WSDOT Sign Fabrication Manual W20-902) or "Signal Revision Ahead" signs (WSDOT Sign Fabrication Manual W20-903) shall be installed by the Contractor on 4-inch x 4-inch wood posts at locations staked by the City Traffic Engineer or the assigned technician for each approach leg prior to the Turn-On date.

These signs shall be maintained by the installer for 30 days. Warning signs shall consist of W3-3 placed on all newly signalized approach legs at a distance from the signal based on condition B, Table II-1, page 2C-2a of the MUTCD. The next sign in advance of W3-3 shall be W20-910, measured 200 feet between warning signs for roadways posted 30 mph or less and 350 feet for roadways with speeds greater than 30 mph.

On the 30th day, the Contractor will remove all advance warning signs. If the Contractor does not remove the advance warning signs at the appropriate time, the City will remove the signs and maintain ownership of them.

New signal heads installed on mast arm and not in the flash mode shall be bagged. Bags shall provide a small visibility hole at each lens. Signal heads can be bagged for a maximum of seven days. New traffic signals shall flash for five days prior to full activation. For some intersections the City's Traffic Engineer will require flash blocks to be with yellow flash on the major road and red on the minor road. Prior to full activation all flash blocks will be set all red flash. Full activation shall occur only on Mondays, Tuesdays, Wednesdays or Thursdays, there shall be no exception to this Turn-On day. If the full activation date falls on a holiday or the day preceding a holiday it will not be allowed. Turn-On to normal cycling operation shall be completed prior to 2:00 PM. The Contractor shall give notice of the Turn-On date and time to the City Inspector five working days in advance of said date.

Traffic signal Turn-On procedures shall not commence until:

1. All required channelization – crosswalks, stop-bars, pavement markings, et al. – have been installed.

2. All required signs have been installed.

Prior to Turn-On, the Contractor shall perform field test 4 as specified in Section 8-20.3(11) in the presence of the City Inspector and City Signal Technician.

Field test 4 shall proceed as follows with signal heads bagged:

1. Turn-On the signal system to its flash mode to verify proper flash indications.
2. Allow the signal system to cycle through no less than five full signal cycles to verify proper operation.

Based on the outcome of field test 4, the City Inspector will direct the Contractor to take the following actions:

1. Remove covers from the signal heads and place the signal system to flash mode for a period of five days.
2. On the designated full activation date, stop all traffic, and set the signal system to full operation.

If testing fails the City Inspector will direct the Contractor to Turn-Off power to the signal system and cover all signal displays with black opaque material until repairs can be made. The Contractor will then reschedule a new Turn-On date with the City Inspector following the procedures given herein.

Immediately following the Turn-On, all conflicting stop and / or yield signs shall be removed as directed by the City Inspector.

8-20.3(13) Illumination Systems

8-20.3(13)A Light Standards

SUPPLEMENT

Luminaires installed on mast arm signal poles shall be energized from a circuit separate from the other luminaires in the system.

8-20.3(14) Signal Systems

8-20.3(14)A Signal Controllers

MODIFICATION

Testing

All signal control equipment shall be tested at the City's Corporate Yard (located at 1100 39th Avenue SE, Puyallup), prior to final delivery. The tests shall check the operation of each individual component as well as the overall operation of the system. Additionally, the City will install the signal operation and timing plans during the testing period.

The City will notify the Contractor of all failed tests and / or rejection of faulty equipment. Contractor shall respond by taking possession of failed and / or rejected parts and replacing them with new of the same manufacture type accepted by the City. Additional time will be required by the City to re-run testing process.

The City testing process will consist of the following stages:

1. Delivery and Assembly
2. Performance Test
3. Operational Test

Testing will follow in the correct order with no time gaps between stages unless mutually agreed upon by the Contractor and City.

Stage 1 Delivery of all Equipment

All control cabinets and control equipment shall be delivered to the Corporate Yard (City Shop) a minimum of three (3) weeks prior to installation for testing. Corporate Yard is located at:

1100 39th Avenue SE
Puyallup, Washington 98374

Manufacturer may deliver equipment directly to the Corporate Yard. Once all components for the complete traffic control cabinet and essential systems has been delivered to the Corporate Yard, the City will test the system to simulate the operations as installed in the field.

Stage 2 Operational Test

All control and auxiliary equipment shall operate without failure for a minimum of fourteen consecutive days. If an isolated controller is specified, it shall operate as an isolated controller. If a coordinated system is specified, it shall operate as a total coordinated system with the master and all local controllers operating in all coordinated modes. If any failure occurs during this stage, all equipment for this stage shall be retested following repairs or replacement parts have been provided by the Contractor.

Equipment Failure or Rejection

Equipment failures shall be defined as set forth in NEMA Publication No. TS 1-1976. Failure of load switches, detector amplifiers, and conflict monitors shall not result in rejection of the controller or cabinet. However, the Contractor shall stock, as replacements, approximately 30 percent more than the total of these three items. All excess material shall remain the property of the Contractor following completion of all tests.

If failure occurs during Stage 2, the Contractor shall make repairs and / or replacements within completed within ten working days following notification of the malfunction by the City. The Contractor shall have the option of making on-site corrections or correct at a site selected by the Contractor. Failure to complete correction within the allotted time shall result in rejection of the controller or cabinet assembly under test.

A total of two failures will be allowed from the start of Stage 2. If three failures occur during this time period, the equipment will be rejected. New equipment of different serial numbers submitted as replacement shall be received by the City's Corporate Yard (located at 1100 39th Avenue SE, Puyallup) for testing within ten (10) working days following notification of rejection. Failure to meet this requirement within the allotted time will result in rejection of the entire system. Software errors will be considered as failures and, if not corrected within ten working days, the entire system will be subject to rejection. Following rejection of any equipment, the Contractor shall be responsible for all costs incurred. This shall include but not be limited to all shipping costs.

All component or system failures, except load switches and detector amplifiers, shall be documented by the Contractor at the request of the City. This documentation shall be submitted prior to commencing the test or stage in which the failure was found and shall provide the following information:

- a. A detailed description of the failure
- b. The steps undertaken to correct the failure.
- c. A list of parts that were replaced, if any.

Upon completion of the tests, the equipment will be visually inspected. If material changes are observed which adversely affect the life of the equipment, the cause and conditions shall be noted. The Contractor will immediately be given notice to correct these conditions. If not repaired within ten working days of notification, the equipment will be subject to rejection. A final accounting shall be made of all equipment prior to approval. All failed or rejected equipment shall be removed from the City's Corporate Yard (located at 1100 39th Avenue SE, Puyallup).

The Contractor will be notified upon completion of testing at which time the cabinet only shall be picked up by the Contractor for installation. The City will install all signal controller components once the cabinet is in place. The City will require five working days to complete the component installation. The Contractor will be responsible for connecting field wiring for all components to field terminal strips.

8-20.3(14)B Signal Heads

SUPPLEMENT

All vehicle and pedestrian signal heads shall be securely covered with opaque (nontranslucent) material between installation and signal turn-on. A small hole will be installed in cover that aligns with each signal lens and pedestrian heads.

All vehicle signal heads shall be approved by the City Traffic Engineer prior to system turn-on.

All signal heads shall be mounted using a Type M or K mount as specified on WSDOT Standard Plans J-6f and J-6g. The Contractor shall provide and install all vehicular signal head mounting hardware. Mounting hardware will provide for a rigid connection between the signal head and mast arm or pole.

Position of the signal heads shall be as specified on the Pole Schedule. Signal heads shall be mounted on the mast arm such that the mount shall be located just below the red indication. The bottom housing of a signal face shall conform to the requirements as stated in the current approved edition of the MUTCD. The highest intensity of the red lens in the signal head shall be aimed at a point 4 times the posted speed limit from the stop bar (measured in linear feet).

Optically programmed heads shall be used for signal heads that are identified in the Plans. The highest intensity of the red lens in the signal head shall be aimed at a point 4 times the posted speed limit from the stop bar (measured in linear feet). Final orientation of the optically programmed heads shall be approved by the City Traffic Engineer in the field.

The type of mounting hardware specified for the mast arm mounted vehicle signals may require modification at the time of installation to accommodate as built conditions. After the pole assembly has been installed and leveled, the Contractor shall measure the distance between each mounting point on the arm and the roadway. A different mounting type shall be used if necessary to achieve the following criteria:

1. Red indications shall be in as straight a line as possible.
2. The bottom of the housing shall be between 16.5 and 19.0 feet above the pavement.

The Contractor shall provide and install the correct type of mounting to achieve the criteria noted above at no additional expense to the owner.

8-20.3(14) C.1 Vehicle Detection

New Section

1. Permanent Vehicle Detection

All permanent vehicle detection shall be by pole mounted detection cameras as specified in section 9-29 of these Special Provisions.

2. Temporary Vehicle Detection

The Contractor is responsible for maintaining vehicle detection at all times on an existing signal system. The Contractor shall furnish and install temporary video detection that can plug directly into existing detector racks for approaches immediately after any loops are disconnected or cut. Video detection shall be positioned and installed as directed by the City Traffic Engineer or Traffic Signal Technician. The video detection system shall be as specified for the permanent video detection.

8-20.3(14)E Signal Standards

SUPPLEMENT

Prior to installation, all poles and associated equipment delivered to the job site shall be stored in a location where they will not inconvenience the public. All poles and arms shall be installed in compliance with Washington State Utility and Electrical Codes.

The poles shall be installed on leveling nuts and washers secured to the anchor bolts and with locking nuts and washers on the top of the base flange. The side of the shaft opposite the load shall be plumbed by adjusting the leveling nuts or as otherwise directed by the City Traffic Engineer or Traffic Signal Technician. The space between the concrete base and the bottom of the pole flange shall be filled with dry pack mortar to completely fill the space under the flange and be neatly troweled to the contour of the pole flange. A barrier shall be placed around the anchor bolts to prevent grout from entering the conduits. A plastic drain hose (3/8-inch diameter) shall be inserted through the mortar to provide drainage from the interior of the pole base and be trimmed flush with the interior and exterior surface of the mortar. Dry pack mortar shall consist of a 1 to 3 mixture of cement and fine sand.

8-20.3(14)F Terminal Cabinets

NEW

In cases where existing signal poles are being modified and the poles do not contain a terminal cabinet, a cabinet meeting NEMA 3R requirements with terminal strip shall be furnished and installed on each traffic signal pole as shown in the Plans. The terminal cabinets shall be mounted on the pole using a 4-inch-wide aluminum channel away from the traffic side, with the bottom of the cabinet above the pedestrian signal heads where present and in no case less than 8 feet above the ground level.

The Contractor shall furnish and install an interconnect cable terminal cabinet(s) at the location(s) shown on the Plans.

8-20.3(14)G Emergency Vehicle Preemption System

NEW

The Contractor shall furnish and install an emergency vehicle preemption system according to manufacturer’s recommendations, the Special Provisions and as shown in the Plans. The emergency vehicle preemption detectors shall be installed in a drilled and tapped hole in the top of the mast arm or on the pole. They shall be tightly fitted to point in the direction shown in the plan view.

The Contractor shall furnish and install phase discriminator units as required to obtain the necessary phase discriminator channels for each leg of the intersection.

The Contractor shall furnish and install detector lead-in cable for the emergency preemption system. No splicing will be allowed between the detector and the controller cabinet.

8-20.3(14)H Pedestrian Push Button Assembly

NEW

The Contractor shall provide and install the pedestrian push buttons and signs on the signal pole.

The push buttons will be mounted to the poles per City of Puyallup Design Standards 01.06.03 and 01.06.04. All mountings shall be securely fastened and approved by the City Traffic Engineer or Traffic Signal Technician.

The position of the pedestrian push buttons shall be located generally so that each point at the crosswalk which the button is intended to serve; however, final positioning for the optimum effectiveness shall be approved by the City Traffic Engineer or Traffic Signal Technician.

8-20.3(17) “As-Built” Plans

MODIFICATION

This section is modified as follows:

Upon completion of the construction and prior to the turn-on of any traffic control equipment, the Contractor shall furnish an “as-built” plan of each intersection showing all signal heads, pole locations, detectors, junction boxes, miscellaneous equipment, conductors, cable wires up to the signal controller cabinet, and with a special symbol identifying those items that have been changed from the original Contract Drawings. All items shall be located within 1-foot horizontal distance and 6 inches vertical distance above, below, or at the surface.

8-20.3(18) Removal of Existing Equipment

New Section

Where specified on the plans, existing signal equipment shall be removed. Unless specified otherwise, all such equipment and materials shall become the property of the contractor and shall be removed from the project site and disposed of at a legal disposal site obtained by the Contractor. Removed equipment and materials shall not be stockpiled at the project site.

Where the plans or special provisions specify that particular items shall be salvaged, they shall be removed and delivered undamaged to the City’s Corporate Yard (located at 1100 39th Avenue SE, Puyallup). The Contractor shall contact the City’s Traffic Signal Technician at (253) 841-5490 five (5) working days prior to delivery. The Contractor shall unload all equipment and materials at the Yard in a location designated by the City.

The foundations, anchor bolts, and conduit for traffic signal mast arm poles shall be removed to a minimum of 24" below new finish grade. Foundations and anchor bolts for all other poles as well as

foundations for controller and service cabinets shall be completely removed. Conduit shall be removed to the bottom of the trench line.

Junction boxes shall be completely removed and the conduit shall be removed to the bottom of the trench line.

All excavations for removal of equipment shall be backfilled with crushed surfacing top course and compacted.

8-20.4 Measurement MODIFICATION

Measurement for the installation of the new system will be by Lump Sum.

8-20.5 Payment MODIFICATION

Payment will be made under:

“Traffic Signal System, (Project Name), Complete”, lump sum
The lump sum bid price in the Proposal shall be full compensation for the costs of all labor, tools, equipment, and materials necessary or incidental to the complete installation of the signal system. Work shall include all electrical signal and illumination equipment, poles, advance warning signs, excavation and backfilling, foundations, conduit, wiring, junction boxes, and restoring all facilities damaged or destroyed during construction, and for all required tests. All additional materials and labor, not shown on the plans or called for herein and which are required to provide a complete and functional signal system, shall be included in the lump sum bid price in the Proposal. Work shall include furnishing all materials, except those to be furnished by the City (if applicable to this project), and for installing all materials including transporting city furnished materials to the project site.

8-22 PAVEMENT MARKING

8-22.1 Description

Work shall include placing pavement marking materials for lane lines, crosswalks, and stop bars, as well as removing existing paint markings.

8-22.2 Materials

Materials for all pavement markings in the roadway shall be meet the City of Puyallup standards noted on the Plans and Details.

8-22.3 Construction Requirements

Pavement marking materials shall be applied to the roadway per manufacturer’s recommendations. Existing pavement markings shall be removed by grinding or other acceptable methods that will completely remove the markings without damage to the pavement.

8-22.4 Measurement

Measurement for the installation of pavement markings will be by lump sum.

8-22.5 Payment

Payment will be made under the following:

“Permanent Pavement Marking”, per lump sum

The lump sum bid price in the Proposal will be full compensation for the costs of all labor, tools, equipment, and materials necessary or incidental to furnish and apply the new markings and remove existing.

END OF DIVISION 8

DIVISION 9

MATERIALS

9-29 ILLUMINATION, SIGNALS, ELECTRICAL

9-29.2 Junction Boxes

SUPPLEMENT

Junction boxes shall conform to Standard Plan J-11a and City of Puyallup Standard Drawing 01.06.01. Concrete junction boxes used exclusively for signals shall be inscribed with the message “TS” as described on Standard Plan J-11a. Concrete junction boxes used exclusively for lighting shall be inscribed with the message “LT” as described on Standard Plan J-11a. Concrete junction boxes used exclusively for interconnect shall be inscribed with the message “INTC” with the same letter size as shown on Standard Plan J-11a. All junction box lids and frames shall be galvanized.

9-29.3 Conductors, Cables

MODIFICATION

A. Signal Cables and Conductors

Electrical conductors shall conform to the requirements of Section 9-29.3 of the Standard Specifications. Signal cable shall have stranded copper conductors and shall conform to IMSA Specification No. 20-1.

B. Interconnect Cable

The copper interconnect cable shall be a 6-pair duct telephone cable, using color coded No. 19 AWG solid conductors with copper shielding and a polyethylene jacket meeting REA Specification PE-39.

C. Illumination Conductors

Illumination conductors shall be USE rated.

9-29.6.1 Light and Signal Standards

9-29.6(1) Steel Light and Signal Standards

SUPPLEMENT

A. Design Requirements

The Contractor shall provide and install all traffic signal and luminaire poles as specified in the Contract Documents. Shop drawings of all steel poles to be installed as a part of this Contract shall be submitted and approved by the City Traffic Engineer before the poles are ordered.

All signal poles, strain poles, mast arms, and signal bridges shall be designed in accordance with the “Standard Specifications for Structural Supports for Highway Signs, Luminaries and

Traffic Signals,” AASHTO, 1994, as revised. 100-mile-per-hour wind speed shall be used for the design of signal poles that will support video detection equipment.

The vertical deflection at the free end of any cantilever arm to the dead load of the signals and signs shall not exceed 2 percent of the cantilever arm length. The horizontal deflection perpendicular to the arm at the free end of any cantilever arm due to the design wind load on the signals and signs and structure shall not exceed 5 percent of the cantilever arm length.

For poles that are NOT on the WSDOT pre-approved list, complete calculations for structural design shall be submitted with the shop drawings for approval before fabrication or ordering material. These calculations shall include the stresses in the pole and cantilever arms; the deflections at the free end of the cantilever; the attachment of the signals and signs to the structure; the connection between the cantilever arms and vertical pole; and the pole section at hand-hole, base plate, anchor bolts, and foundation. All materials, construction, and assembly shall be as specified herein and on the Pole Schedule.

B. Fabrication Requirements

1. Tapered Shafts

The pole, luminaire davit top, and mast arm shafts shall be round in cross section and have a uniform taper. The taper shall continue through the luminaire davit radius.

The pole shaft and signal arm shall not vary in roundness greater than 1/16 inch in the straight sections of the mast arm assembly. Longitudinal seam welds in the shafts shall meet AASHTO, 1994, as revised.

All butt welds in the shafts shall have back-up rings and full penetration for 100 percent of the circumference and shall conform to all applicable sections of the Standard Specifications.

The round tapered pole shaft shall be made of 1-ply, hot rolled, basic open-hearth steel. Structural steel having a minimum yield point of 40,000 psi or more shall be used for all structural parts and shall be galvanized after fabrication in accordance with ASTM A123.

A flange plate for the purpose of mounting the vehicle signal mast arm on the pole shaft shall be attached to the pole shaft and shall be supported with side plates tangent to the shaft and gusset plates both top and bottom. Provisions for installing the signal wires between the vehicle signals and pole shaft shall be provided. All materials and construction shall conform to the Pole Schedule.

2. Luminaire Attachment

Only the traffic signal poles so indicated in the Plans shall be equipped with davit style luminaire arms, and shall incorporate a smooth 5-foot 9-inch radius bend at the end. A pipe tenon of diameter and length specified by the lighting manufacturer shall be provided in the end of the arm for attachment of the luminaire. A tenon shall be 2 degrees above level at the end.

Those traffic signal poles not equipped with luminaire arms shall include a luminaire extension plate with removable pole cap per City of Puyallup Standard Drawings.

3. Hand holes and Terminal Can

Shall meet requirements specified in City of Puyallup Standard Drawing 01.06.02.

All terminal cans be internal terminals strips with stainless steel locking hinged doors as specified in City of Puyallup Standard Drawing 01.06.02.

4. Vehicle Signal Mast Arm

The shaft end of the mast arm shall have a steel flange plate welded to it that will permit the arm to be securely mounted on the flange plate specified for the pole shaft.

The flange plate shall telescope the large end of the arm and shall be welded by 2 continuous electric arc welds, one being on the outside of the plate, adjacent to the shaft, and the other one on the inside at the end of the tubular cross section. The flange plate shall have 4 holes for the high-tensile bolts, which shall match the 4 tapped holes in the mounting plate on the pole shaft, as well as an opening to match that provided in the pole shaft for installing the signal wire.

Tenons shall be welded to the mast arm at locations specified on the Pole Schedule in the Plans, for the purpose of mounting the traffic signals. Unused tenons shall have a secure detachable cover.

5. Anchor Base

A 1-piece steel anchor base shall be secured to the lower end shaft by 2 continuous electric arc welds. The base shall telescope the shaft and the one weld shall be on the inside of the base at the end of the shaft, while the other weld shall be on the outside at the top of the base as indicated on the Pole Schedule. The design shall be such that the welded connection shall develop the full strength of the adjacent shaft section to resist bending action.

Four (4) holes of adequate size to receive the anchor bolts shall be drilled in the base. Slotted holes $\frac{1}{4}$ inch maximum larger than the anchor bolt diameter shall not be permitted.

Two-piece anchor bolt covers shall be included and provisions made for mounting same with stainless steel screws.

6. Anchor Bolts

Four (4) steel anchor bolts, nuts, and washers shall be furnished with each pole. Each anchor bolt shall have 1 round bearing plate with 1 hex nut tack welded to the bottom of the plate and shall have 7-inch-minimum thread on the top. Anchor bolt dimensions shall be per manufacturer's specifications. All anchor bolts shall be furnished complete with 2 heavy hex nuts and 2 hardened washers. The threaded end of the bolts and all nuts and washers shall be galvanized in accordance with ASTM A153.

7. Delivery

Scratching, marking, denting, or other damage to poles and fittings at the point of delivery shall be cause for rejection.

9-29.6.2 Luminaire Fusing and Electrical Connections at Light Standard Bases

SUPPLEMENT

Light standards shall be equipped with 2 in-line fuse holders with the fuses mounted inside the pole and readily accessible from the hand hole. Fuse holders shall be SEC Model 1791-SF with FNM-5 or approved equal.

9-29.10 Luminaries

MODIFICATION

The luminaries to be furnished and installed by the Contractor on this Project shall meet the general requirements of Section 9-29.10 of the Standard Specifications except as modified by the following:

Luminaries shall meet City of Puyallup Standard Drawings 01.05.01 through 01.05.04. The housing shall be finished in a durable gray Lektrocote and employ a 2-door system as manufactured by General Electric Lighting. Shielding of 75 degree C rated wire shall be required where needed.

The lamp shall be installed by the Contractor to give a medium, cutoff, type III light distribution pattern. The Contractor shall obtain the correct socket setting necessary to achieve this pattern from the luminaire manufacturer and shall install the lamp in the setting. All lamps shall be dated by scribing on the base of the lamp the month and year that the lamp is installed.

9-29.12(2) Traffic Signal Splice Material

SUPPLEMENT

No underground splices of signal conductors or detector lead-ins will be permitted.

9-29.13(1) Traffic Signal Controller Program

NEW

Contractor shall supply one (1) signal controller software program with all associated documentation and licenses as part of the system. This software shall be the most recent version of Traffic Signal Program Version 233 by Bi-Trans Systems, Inc.

9-29.13(2) Flashing Operations

SUPPLEMENT

The signal on/off switch shall have a guard to prevent inadvertent switching.

9-29.13(3) Emergency Preemption

SUPPLEMENT

All emergency vehicle preemption equipment and materials shall be the Opticom™ emergency vehicle preemption system. The emergency vehicle preemption system shall enable an authorized vehicle to remotely control traffic signals from a distance of up to 1,800 feet along an unobstructed line-of-sight path. The emitter assembly shall have a beacon light mounted above to indicate to the vehicle operator that the signal has been acknowledged.

The emergency preemption detectors shall be 721 series Opticom™ detectors. The detectors shall be capable of detecting an optical signal generated by an Opticom™ brand emitter assembly. The detectors shall detect the optical signals from the emitter, amplify the signal, and transmit it to the phase selector.

The emergency vehicle preemption system at the intersection shall operate in accordance with the appropriate phase diagram shown in the plans. Detectors shall be installed at the locations shown in the Plans.

The detector lead-in cable shall be Opticom™ Model 138 shielded detector cable. Detector cables shall be continuous from detector to controller cabinet without splicing. Both ends shall be terminated in accordance with manufacturer's specifications.

9-29.13(7) Traffic-Actuated Controllers

SUPPLEMENT

The Contractor shall furnish the latest 170 type controller unit (per FHWA-IP-78-16) supplied with an Ethernet modem installed.

The Contractor shall furnish a Model 412-C prom module with the Model 170 unit which has been completely programmed and ready for operation with the intersection phasing configuration and shall be available when the signal control equipment is delivered to the City for testing. The backup power for the memory module shall be provided by a super capacitor, not a battery.

The controller unit shall be warranted for a period of 2 years. All warranty periods shall begin at the date of shipment.

9-29.13(7)B Auxiliary Equipment for Traffic Actuated Controllers

All auxiliary equipment for traffic actuated controllers shall comply with applicable provisions of Section 9-29.13(7)B for Type 170 controller cabinets of the Standard Specifications except as modified herein:

Cabinet Equipment

The cabinet shall be provided with a thermostatically-controlled ventilation fan adjustable between 80-150 degrees. The fan shall be ball bearing type and shall be capable of drawing a minimum of 2.84 cubic meters (100 cubic feet) of air per minute.

A front and rear fluorescent light shall be provided and mounted in the cabinet to sufficiently illuminate the field terminals. The lamp shall be wired to a door-activated switch located at the top right of the door opening.

Cabinet Components

Load Switches. The front panel shall have indicators to show the state of each input and output circuit of the load switch. Every load switch bay slot shall have dual indicating type 200 load switches with LED indications installed. MFG. POC model SSS-871/0 or pre-approved equal.

Conflict Monitor. Cabinets shall use a model 210N conflict monitor.

Cabinet Power Supply. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes. One (1) power supply shall be furnished with each cabinet assembly.

Detector Amplifiers. A minimum of 8 detector amplifiers shall be provided with each cabinet assembly. Reno A&E mfg. Model C-1100 series 332/170 type inductive loop detectors are approved under these specifications.

Detector Test Panel. A detector test panel shall be included in all controller cabinets.

Pull-out Drawer. A print holder roll-out drawer shall be provided. The drawer shall be rack mounted below the controller.

Terminal Strip. Cabinets shall have interconnect terminal strip with surge protector and interconnect patch cable.

Preemption Devices. All system components shall be the 3M™ Opticom™ System now in use by the City of Puyallup. Discriminator modules approved under these Specifications are the 3M™ Opticom™ Model 762. The preemptor shall not flash the pedestrian yellow outputs in the field. Two (2) discriminators shall be supplied with each cabinet assembly.

9-29.13(7)D Controller Cabinet

MODIFICATION

The Contractor shall provide and install one fully equipped Model 332 cabinet to house a controller unit and auxiliary equipment. The cabinet shall be pad mounted in accordance with the City of Puyallup Plans and details and shall be provided with a Best CX series construction core. Cabinet shall be anodized aluminum .125 inch minimum thickness.

The fully equipped Model 332 cabinet has both a front and rear door for ease in connecting field wires, and overall maintenance simplicity. Integral EAI rails provide rack mounting of the Model 170 Controller, the eleven-position Input file, the Power Distribution Assembly, and an Output File that provides for 12 load switches. A light shall be mounted over the rear door and over the front door near the top with a door switch to automatically energize when the corresponding door opens. A front door switch will allow signal to operate without a conflict monitor when the door is open and will cause immediate flash if door is closed without 210.

The traffic signal controller cabinet shall be wired for and contain the equipment specified in the Contract Plans, Special Provisions, and the WSDOT Standard Specification. Cabinets shall conform to Section 9-29.13(7) of the WSDOT Standard Specifications, as amended.

Component name tags for relays, switches, circuit breakers, and special logic packages shall be provided and located adjacent to the component, describing the component's function within the composite signal system.

The cabinet shall have a panel with 8 vehicle and 4 pedestrian detector switches. Each switch shall provide a spring loaded momentary contact that will place a call into the controller.

If the manufacturer of the control equipment employs a different numbering system in the fabrication of control components, then both numbers shall appear on the field terminal strips in the controller cabinet. Manufacturer's number shall appear on one side and the City of Puyallup's shall appear on the other side. All manufacturers wiring diagrams shall have added thereto at the field termination point the field wiring numbering system.

One terminal for power shall be supplied for each signal light circuit, and one or more terminals shall be supplied for the common conductors. The neutral busbar shall be un-fused.

All harness and cabinet wiring shall be neatly laced or bound together with nylon wraps or equivalent. All terminals shall be numbered and identified in accordance with the cabinet wiring diagram. Common wires need not be numbered. All installed field wiring shall be kept off the cabinet floor to allow cleaning.

The cabinet shall have a power distribution assembly and 24 VDC ferro-resonant power supply in a plug-in unit. A transient voltage protection device shall be provided, connected to the output side of the

control-display breaker for protection against voltage abnormalities or less than one-half cycle duration. The protector shall be solid state high energy circuit containing no spark gap, gas tube, or bar component. The current rating of the device shall equal or exceed the control-display breaker current rating. The protection provided shall be a transient suppression of 200 volts-peak, a transient response of less than five nanoseconds, a power dissipation of 10,000 watts, an overvoltage strip of 135 volts RMS and an overvoltage response of five seconds. The protector shall function with a 10 x 1,000 microsecond waveform clamping no greater than 200 volt peak.

Insulated terminal blocks of sufficient number to provide a termination for all field wiring, with a minimum of twelve spare terminals, shall be provided. Terminal blocks shall be 600 volt, heavy duty, barrier type. Each connector shall be a screw type with No. 10 post capable of accepting no less than three No. 12 AWG wires fitted with insulated locking spade tips.

The cabinet fan thermostat shall be located within 2 inches of the cabinet ceiling.

The Contractor shall also provide the City with two sets of controller schematics, wiring diagrams, and two copies of the maintenance manual for the controller.

The controller cabinet shall also include an Ethernet hub to accommodate input from the signal controller, the broadband antenna, the detection camera, the PTZ camera, and the battery backup system.

The controller cabinet shall also incorporate a 6" riser between the bottom of the cabinet and the foundation.

9-29.16 Vehicular Signal Heads

MODIFICATION

9-29.16(2) Conventional Traffic Signal Heads

All vehicle signal heads shall comply with applicable provisions of Section 9-29.16 of the Standard Specifications except as modified herein:

The vehicle signal heads shall be constructed of corrosion resistant, die-cast aluminum alloy and shall be equipped with tunnel-type visors and shall have a flat back mounting. All exterior surfaces of the signal head housing, doors and visors shall have an electro statically powder-coated finish, color flat black. The vehicle signal heads shall be installed with LED indications for all sections. Indications shall be latest ITE specification Dialight LED.

Vehicle signal heads shall have 12-inch lenses for all indications. The highest intensity of the red lens in the signal head shall be aimed at a point 4 times the posted speed limit from the stop bar (measured in linear feet).

All vehicular signal heads shall be equipped with 12-inch aluminum tunnel visors.

9-29.16(2)E Painting Signal Heads

MODIFICATION

All signal heads and mounting hardware shall be finished with two coats of factory applied flat black enamel.

9-29.18 Vehicle Detector

Vehicle detection on all approaches shall be by video camera.

The processing module in the controller shall be capable of both counting and detecting without replacement of the module.

The complete video system shall be compatible with the controller and associated controller cabinets and cabinet equipment described in Section 9-29.13(7) of these Special Provisions. The system shall be able to detect vehicle presence with 98 percent accuracy under normal conditions (days and nights) and 96 percent accuracy under adverse conditions of fog, rain, and snow.

Materials

The video detection system shall be as furnished by Traficon, or equal, with the following specifications:

1. Video detection modules VIP 3.1 and VIP 3.2 for one and two cameras respectively.
2. Video camera(s) with IR filter, lens, enclosure, and sun shield.
3. Signal mast arm sensor bracket(s).
4. Surge suppressor.
5. Programming devices and/or software.
6. Coaxial/power cable.
7. All other necessary equipment for operation.
8. Traficon Viewcom module for each camera

Video Detection System

The Video Image Processor (VIP) shall be modular by design and shall fit directly into NEMA TS1 and TS2 type racks. The VIP shall be interchangeable between a shelf or rack-mount installation without replacing or modifying existing VIP units.

The system shall control from one to four VIP boards allowing for one to eight image sensors.

The system shall be designed to operate reliably in the adverse environment of roadside cabinets and shall meet or exceed all NEMA TS1 and TS2 environmental specifications.

Ambient operating temperature shall be from minus 35 to plus 75 degrees centigrade at 0 to 95 percent relative humidity non-condensing.

The system shall be powered by 12 to 40 Vdc and draw less than 2 Amperes.

The system shall utilize cabinet 24 Vdc for rack-mount installations or external 24 Vdc for stand-alone shelf installations.

Surge ratings shall be set forth in the NEMA TS1 and TS2 specifications.

Serial communications shall be through an RS232 serial port. This port can be used for communications to a modem or laptop to upload/download detector configurations, count data, and software upgrades. RS485 on the rear edge connector shall facilitate communications to other VIP boards.

Each VIP board shall have four opto-isolated open collector outputs. Twenty additional outputs shall be available via the expansion port. The VIP/3D shall have 20 presence detection zones and four data detection zones. Data zones shall collect and store vehicle counts, volume, speed, gap time, headway, occupancy, and classification. Data shall be time-stamped and stored onboard (nonvolatile memory) in intervals from 1 to 60 minutes.

Each VIP board shall allow for 20 digital inputs via the I/O expansion port.

Each VIP board shall have error detection. An output contact will open if the video signal is bad or the VIP board is not functioning properly. A user-defined quality level will automatically put the VIP into a recall state in cases of severe degraded visibility (i.e., fog, blizzard, etc.). Normal detection resumes when visibility improves above the user-defined quality level.

Operator selectable recall shall be available via the VIP front panel.

A video select button on the VIP front panel will switch between camera images of the VIP.

The VIP board shall have two video inputs (RS 170 NTSC or CCIR composite video) and one video out.

The VIP board shall have a reset button on the front panel to reset video detectors to “learn” the roadway image. Learning time of video detectors shall be less than 10 seconds.

External surge suppression, independent of the VIP board shall separate the VIP from the image sensor.

The VIP board shall have separate light emitting diodes (LEDs) that indicate:

1. POWER Red to verify power supply.
2. I/O COMM Red to indicate communications to expansion boards.
3. VIDEO 1 and 2 Red to verify the presence of video input 75 ohm.
4. TX and RX Red to indicate communications via the serial port.

- OUT1 to OUT4 Green if the corresponding detection group is active.

The VIP board shall also have two separate buttons for:

1. VIDEO SELECT
2. RECALL Manually places call on detectors.
3. RESET Manually reset detectors to “learn” new background.

The VIP board shall also have a video out female RCA style connector, DB9 female service port, and DB9 I/O expansion port.

The VIP expansion board shall also have separate LEDs that indicate:

1. POWER Red to verify power supply.
2. COMM Red to indicate communications to VIP board.
3. I/O1 to I/O4 Green if the corresponding detection group is active.

The VIP expansion board shall have eight dip switches that define inputs and outputs used (Range: 1 to 12 or 13 to 24).

Camera

The camera shall be a high resolution, 1/3-inch image format CCD camera, designed for professional video surveillance systems. The video camera shall provide detailed video imagery without lag, image retention, or geometric distortion.

The camera shall incorporate the following features:

1. Temperature Range: Minus 20 to plus 55 degrees C.
2. Humidity: 0 percent to 95 percent relative, non-condensing.
3. Dimensions: 47 mm by 47 mm by 83 mm.
4. Weight: 200 g.
5. Camera Mounting Slots: 1/4-20, top and bottom.
6. Connectors: BNC for video out.
7. Lens Mount:
 - A. CS.
 - B. Power-in/pressure screw.
 - C. Lens/four-square connector.
8. Finish: Off-white semi-gloss polyurethane.
9. Construction: All metal housing.
10. Rated Input Voltage: 12 Vdc or 24 Vac, plus or minus 10 percent at 60 hertz.
11. Nominal Power: 60 Watts.
12. Imager: Interline transfer CCD 1/3-inch format.
13. Imager Spectral Response:

- D. 100 percent at 550 nm.
- E. 30 percent at 400 nm and 800 nm.
- 14. Sync System: EIA RS-170.
- 15. Active Picture Elements: 768 H by 494 V.
- 16. Horizontal Resolution: 580 TVL.
- 17. Sensitivity (2,856 K):

		<u>Usable Picture</u>	<u>Full Video</u>
Scene Illumination:	fc	0.012	0.08
	lx	0.12	0.8
Imager Illumination:	fc	0.0015	0.01
	lx	0.015	0.1

*F1.2 lens at 75 percent highlight.

- 18. Signal to Noise Ratio:
 - F. 54 dB minimum.
 - G. 58 dB typical.
- 19. AGC: 18 dB.
- 20. Light Range (AGC on): 1,000,000:1 min. with f/1.4 to 360 auto-iris lens.
- 21. Video Out: 1.0 Volts peak-to-peak plus or minus 0.1 Volt at 75 ohms.
- 22. Gray Scale: At least 10 steps.

Lens

The camera lens shall be a motorized vari-focal 6.5 to 39 mm with auto iris with the following features:

1. Image Format: 1/3 inch.
2. Focal Length: 6X zoom (6.5 to 399 mm).
3. Iris Range: f 1.0 to approximately 1,200.
4. Back Focus Distance: 10.05 mm (0.4 inch) in air.
5. Weight: 500 g.
6. Size: 60 mm by 70 mm by 89.9 mm.
7. Lens Mount: CS.

8. Iris Control: DC or Video 4 pin square.
9. Focus Control: Motorized.
10. Zoom: Motorized.

Housing

The camera housing shall be an aluminum enclosure designed for outdoor CCD camera installations with the following features:

1. Temperature Range: Minus 40 to plus 50 degrees C.
2. Dimensions: 449 mm by 97 mm by 112 mm.
3. Weight: 1.4 kg.
4. Housing Mounting: Three 1/4-20 tapped holes.
5. Camera Mounting: Removable cradle assembly.
6. Cable Entry: Three liquid-tight fittings that will accept cable diameters of:
 - H. One fitting – 2 to 7 mm.
 - I. Two fittings – 3 to 10 mm.
7. Finish: Off-white semi-gloss polyurethane.
8. Construction: Extruded aluminum housing, aluminum rear-end cap, aluminum front cap with glass faceplate, and aluminum cradle. A sunshield shall be included.
9. Window: 3-mm-thick glass that includes a thermostatically controlled window heater/defogger strip.
10. Rated Input Voltage: 115 Vac 60 Hz.
11. Voltage Range: 108 Vac to 132 Vac.
12. Output Voltage: 24 Vac 60 Hz.
13. Nominal Power: 30 Watts.
14. Enclosure Protection: Waterproof and dust-tight in a NEMA-4, IP65, enclosure Type 3.

Surge Protector

A video surge suppressor(s) shall be installed inside the traffic signal controller cabinet. The suppressor shall provide coaxial cable connection points to an EDCO CX06-BNCY or approved equal transient suppressor for each image sensor and shall incorporate the following features:

1. Peak Surge Current (8 by 20 us): 5 kA.
2. Technology: Hybrid, Solid State.
3. Attenuation: 0.1 db at 10 MHz.
4. Response Time: Less than 1 nanosecond.
5. Protection: Line to ground.
6. Shield to Ground: Isolated shield modules.
7. Clamp Voltage: 6 Volts.
8. Connectors: BNC.
9. Impedance: 75 Ohms.
10. Temperature: Minus 40 to plus 85 degrees C.
11. Humidity: 0 to 95 percent non-condensing.
12. Dimensions: 4.5 inch by 1.5 inch by 1.25 inch.
13. UL Listed: UL 497B.

Mounting Bracket

The camera mounting bracket shall be designed to attach to the traffic signal pole mast arm at a location and height that will prevent occlusion from cross traffic. The bracket shall consist of an internally reinforced tube that will provide a minimum mounting height of 6 feet above the mast arm. The camera shall be mounted on the top of the tube with the camera manufacturer's recommended mounting bracket. When mounted, the camera shall be capable of horizontal and vertical adjustment as well as being rotated 180 degrees on the bracket to detect vehicles entering as well as leaving the intersection on a particular approach.

The entire system, extension tube, mounting bracket, and camera shall be designed to withstand a wind load of 90 miles per hour with 30-second gust factor without failure.

All miscellaneous mounting hardware shall be stainless steel or hot-dipped galvanized steel.

The coaxial power cable shall be suitable for exterior use and in direct sunlight. The cable shall have a minimum of five conductors.

The cable shall be terminated in the surge suppressor before being connected directly to the VIP boards.

The complete system shall function as follows:

1. Each VIP board shall be capable of processing the video signal of one camera. The video signal shall be analyzed in real time (30 times per second).
2. The system shall be expandable up to eight cameras that may be connected to different VIP units and programmed independently.
3. The system shall be capable of displaying detectors on the video image with associated outputs. Output/input status will be indicated on the screen. Parameters will also include the ability to view raw video without any verbiage and/or detectors for surveillance purposes.
4. Each VIP board will detect within the view of the connected camera the presence of vehicles in user-defined zones. Detectors available shall be presence, count, delay, extension, or pulse mode of either arrival or departure of vehicles. Delay and extension shall be defined between .1 to 99 seconds and pulse mode between 20 ms to 100 ms in 20-ms increments.
5. The VIP board shall be programmed without the use of a supervisor computer. A standard CCTV monitor and keypad lugged into the VIP serial port will facilitate detector programming.
6. The VIP board shall store up to four detector configurations. It shall be possible to switch between detector configurations manually or automatically by time of day or input from the traffic controller.
7. Via the serial port, detector configurations can be uploaded to a laptop and stored on disk.
8. Detectors may be linked to 24 outputs and 20 inputs using Boolean Logic features: AND, OR, NOT. It will be possible to generate conditional outputs based upon inputs from a controller.
9. It shall be possible to make a detector directional sensitive. Options will include an omni-directional detector or a detector that only senses movement: from right to left, left to right, up to down, or down to up as you look at the monitor.
10. To facilitate “fine tuning” of detection zones, a maximum of ten lines and a minimum of four lines may be adjusted within the confines of the detector.
11. All detectors and parameters can be changed without interrupting detection. For example, when one detector is modified, all existing detectors continue to operate including the one that is being modified. When the new position is confirmed, the new detector will enter a learning phase. Once the new detector is in function, it will take over the job of the old one. In this way, the detector is always fully operational with no interruption on any detector, even during modification. Learning phases for new detectors shall not exceed 10 seconds.
12. Four detectors per module may be used as data detectors. Data detectors will detect and store informational data at user-defined intervals of 1, 5, 10, 15, 30, and 60 minutes. It shall be possible for each VIP board to store up to 4,000 intervals of data in nonvolatile memory.

13. Associated software may be used with a PC to download count data and export to a spreadsheet. Software will also be used to upload/download detector configurations and update software versions of the VIP board.
14. The VIP modules shall have the option of password protection to four levels.

9-29.18(4) Pan/Tilt/Zoom (PTZ) Camera System

A PTZ camera system shall be furnished and installed as directed by the City Traffic Engineer. The unit shall be a Spectra IV SE Series Dome System suitable for outdoor operation when pendant mounted on a traffic signal pole. The camera unit shall be a Color (22X) model unit. Optional accessories shall include a TXB-IP Series connection for broadcast by Ethernet equipment. Complete specifications are included in the Appendix D.

9-29.19 Pedestrian Push Buttons

Section 9-29.19 is supplemented with the following:

The pedestrian push-button assembly shall be a Dura-Ped box mount with four mounting holes. The button shall be gray in color. See City of Puyallup Standard Drawing 01.06.04 for additional details.

9-29.20 Pedestrian Signals

Section 9-29.20 is supplemented with the following:

The pedestrian signal head shall be Dialight LED with countdown timer, model number 430-6479-001. Complete specifications are included in Appendix D of these Special Provisions.

The case shall be a one-piece corrosion-resistant aluminum alloy die-casting. Integrally cast hinge lug pairs, two at the top and two at the bottom of each case, shall be provided for the operation of a swing-down door. Prior to final assembly, the case, doorframe, and "Z" crate visor (aluminum portion only) shall be thoroughly cleaned and chromate conversion coating applied inside and out per Military Specification MIL-C-5541. Synthetic enamel conforming to Military Specifications TTE-529 shall then be electro statically applied. Color shall be flat black. The finish shall be oven cured for a minimum of 20 minutes at 350 degrees F. The unit shall be mounted with Type E mountings.

9-29.24 Service Cabinets

MODIFICATION

The service cabinet shall be a Skyline Electric Drawing No. 47995-P2 or pre-approved equivalent. A copy of the wiring diagram shall be provided in a plastic holder mounted conveniently inside the service cabinet. Nameplates shall be provided for each control component and shall be embossed phenolic with white letters on black background.

Cabinets shall be constructed from anodized aluminum. Cabinets shall be painted white on the inside.

The service cabinet shall be equipped with a meter base at the top of the cabinet door. The meter base shall be provided with a suitable device for providing circuit continuity in lieu of a meter that may be added at a future time.

The service cabinet wiring shall be arranged so that any piece of apparatus may be removed without disconnecting any wiring except the lead to that piece of apparatus. All wiring shall be appropriately marked with a permanent, indelibly marked, clip sleeve wire marker. Control wire shall be 7-strand No. 14 AWG THHN and all wiring shall conform to NEMA Class II C.

The service cabinet shall as a minimum provide the following:

- 4 JAW, 200-amp meter base.
- 125-amp 2P main breaker.
- 50-amp 1P signal branch.
- 15-amp 2P illumination branch (3).
- 30-amp 2P mag lighting contactor (3).
- 15-amp 1P control branch.
- 15-amp 1P lighted sign circuit.
- Test switch to bypass remote photo control.

There shall be space within the cabinet for the future addition of 2 time clocks and 3 additional contactors. Each service cabinet door shall be equipped with 3-point latch and provisions for a padlock.

The service cabinet shall be shipped and delivered to the job site in a protective covering with suitable wrapping to prevent damage to the exterior finish.

The service cabinet must meet current PSE requirements and it will be the responsibility of the Contractor to confirm equipment meets their requirements.

The cabinets shall meet all applicable provisions of Labor and Industries and shall be labeled for service entrance use.

9-29.25 Amplifier, Transformer, and Terminal Cabinets

MODIFICATION

A. Recessed Terminal Compartment

Recessed terminal compartments shall be provided on each signal pole as shown in City of Puyallup Standard Drawing 01.06.01. Each cabinet shall have sufficient terminal blocks, with No. 10 lugs, to accommodate the conductors shown in the Wiring Schematic, plus 25 percent spare capacity.

The cabinet shall be gasketed with a 1-piece closed-cell neoprene gasket to provide a weatherproof and dust-proof seal. The cabinets shall be gray in color.

A door with stainless steel piano hinge shall be installed to provide complete access to the interior of the cabinet. The door shall be equipped with a lock that shall be capable of accepting a Best BM Series core.

9-29.26 Internally Illuminated Street Name Signs

New Section

Internally illuminated street name signs shall meet the requirements for “LED Illuminated Street Name Signs” included in Appendix D of these Special Provisions.

9-29.27 Wireless Interconnect**New Section**

Wireless interconnect equipment shall be Encom Broadband Wireless meeting the Specifications contained in Appendix D of these Special Provisions.

9-29.28 Uninterrupted Power Supply**New Section**

The Uninterrupted Power Supply unit shall be as manufactured by Alpha and meeting the requirements of the specifications in Appendix D. The cabinet shall be designed to either mount on the side of the controller cabinet or on the concrete foundation adjacent to the controller cabinet. The cabinet shall be equipped with a Best lock. The unit shall also contain provisions for being monitored at a remote location by the Ethernet unit.

END OF DIVISION 9