

TRAFFIC SIGNALS DESIGN GUIDELINE, PLAN NOTES, AND INDEX **(Revised January 2025)**

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I. INTRODUCTION

This Section contains information about traffic signals and is intended to be used by designers, consultants, and contractors, as well as serve as a reference for internal use.

II. DESIGN

A. GENERAL PROCEDURE

1. Prior to beginning design, develop a scope of work approved by transportation engineering and traffic signal maintenance.
2. Consider signal spacing and timing for signals that are designed to operate as a system. Provide documentation that the system can operate reasonably under future year volumes.
3. Obtain information on existing and future traffic conditions pertaining to the location under consideration. This information includes but it is not limited to hourly and daily volumes, land uses, prevailing speeds, and collision history.
4. Unless other information is available, assume that the 85th percentile speed is five mph higher than the posted speed limit.
5. All signal projects should be consistent with and fit within the framework of the city's ITS (Intelligent Transportation System) plan.
6. All traffic signals should be connected to the city fiber network. Verify equipment needed and path of connection with the Information Technology Department.
7. On corridors that extend or could extend into an adjacent city or that include traffic signals operated by other agencies, contact those agencies for their comments on design. Obtain comments from King County Metro and Sound Transit where buses operate through a project.
8. Whenever possible, procure traffic signal equipment including cabinets, controllers and pluggable devices from state contract. Equipment purchased this way results in lower project cost.
9. Traffic signal design plans shall be signed and stamped by a registered Professional Engineer (PE) in the State of Washington with recent, relevant experience doing traffic signal design work.

B. PLANS

1. The plans should show all existing and proposed traffic signal appurtenances including but not limited to:
 - a. Junction boxes
 - b. Conduit and wiring
 - c. Cabinets (signal, terminal, service)
 - d. Poles (signal, pedestrian, CCTV)
 - e. Signal heads (vehicle, pedestrian)
 - f. Overhead and underground utilities
 - g. Right of way

- h. Power source
 - i. Channelization
 - j. Detection
 - k. CCTV cameras
 - l. Signs
 - m. Emergency pre-emption equipment
- 2. The plans should include schedules of both existing and proposed:
 - a. Junction boxes by type
 - b. Conduit/wiring
 - c. Signs by type
- 3. The plans should have a plan sheet for mast arms showing street name position, directional signs and 10' terminal cabinet. See WSDOT Signal Standard IS-13.

C. DESIGN CONSIDERATIONS AND REQUIREMENTS

1. PHASING

- a. Phase labeling shall be in accordance with CK-TS.01. Phase labels are based on cardinal directions. For example, phase 4 is northbound thru, phase 6 is eastbound thru.
- b. Left turn phasing is determined by the guidelines in Section 4.3.6 of the FHWA Signal Timing Manual.
- c. At certain locations pedestrian volumes and accidents may require protected only left turns. Determination shall be on a case-by-case basis.
- d. Blank out "No Right Turn on Red" signs shall be used for right turns that may conflict with dual lefts (MUTCD, Section 2B.60)
- e. Blank out "No Right Turn on Red" signs should be operated through a load switch and not hard wired.
- f. Consider the possibility of U-turns and the need for "No Right Turn on Red" Blank Out signs.
- g. Consider right turn overlaps wherever exclusive right turn lanes are used. See CK-TS.01 for overlap labeling.

2. VEHICULAR SIGNAL HEADS

GENERAL

- a. Use aluminum led signal heads factory painted federal green.
- b. Use programmable heads only with approval of Public Works Transportation Engineering.
- c. Use four section bi-modal heads not five section heads.
- d. Back plates shall be installed on all signal heads mounted over the roadway. All back plates shall have a two-inch yellow reflective strip around its perimeter.

SIGNAL HEAD PLACEMENT

- a. Submit documentation that shows signal head meet placement and visibility requirements of MUTCD and WSDOT (MUTCD Table 4D-2 for example)
- b. Field check to evaluate the effects of existing and proposed trees on visibility of signal heads, cameras and emergency vehicle preemption receivers. Propose mitigation when necessary.
- c. Supplemental signal heads should be mounted in a far-left configuration for protected only left turns.
- d. Provisions (including cables, tenons, etc.) shall be made for the future installation of protected left turn heads wherever permissive only or protected/permissive left turns are being installed.

BLOCKING DUE TO OVERHEAD UTILITIES

- a. Attempts should be made to clear signal heads from blockage due to overhead cables.
- b. The city must share the cost of undergrounding existing overhead utilities.
- c. No new utilities facilities can be located overhead, but existing overhead utilities can be upgraded.

3. PEDESTRIAN SIGNAL HEADS

- a. Countdown signals are required.
- b. All pedestrian signal heads on a type I pole shall be "clamshell" mounted not top mounted. See WSDOT Standard Plan J-75.10-01, Type E.

4. PEDESTRIAN PUSH BUTTON ASSEMBLIES

- a. Locate pedestrian push buttons assemblies in accordance with relevant sections of the most current MUTCD. Where feasible pedestrian push buttons shall be located 10 ft or more apart.
- b. Pedestrian push buttons shall be accessible and programmed in accordance with the most current MUTCD.
- c. See City of Kirkland Pre-Approved Plan CK-TS.12 for details.

5. POLES AND MAST ARMS

GENERAL

- a. All signal poles shall be separated from vehicular traffic by at least five feet.
- b. Unused holes or holes left after permanent removal of existing signal pole mountings shall have plates welded on them and the plates shall be cold galvanized.
- c. Use [WSDOT standard plans](#) for Type I, II, or III signal poles. Those structures have been designed according to the Fifth Edition 2009 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Basic wind velocity is 90 mph, Design Life/Recurrence Interval of 50 years, and Fatigue Category III.

- d. Due to the design life of the structure, if a Type I, II, or III signal pole is within the construction limits of, abutting, or reasonably adjacent to, any ground-disturbing Project, **the Project will be required to replace signal pole foundation, signal pole, and mast arm assemblies that will be more than 50 years old at the time of substantial Project completion.** Projects that shall comply with this requirement include new construction, reconstruction, development frontage improvements, ground-disturbing restoration, or alterations of existing roadway and sidewalk facilities. Regular maintenance activities such as striping or re-striping, sidewalk repair, utility repair, traffic signal repair, and traffic signal alterations that do not require ground-disturbing activities, are excluded from this requirement.

MAST ARM LOAD CALCULATION

- a. Calculate the wind loading of all proposed and existing equipment to be placed on mast arms including signs, vehicle signal heads, luminaire arms, etc. Follow the requirements set forth in the WSDOT standard plans. See [WSDOT Traffic Signal Standard Chart IS-13](#) for details.
- b. Where new equipment is placed on existing mast arms, demonstrate that existing foundations, poles, and mast arm assemblies can support proposed loads within the original design value for that assembly. If proposed values for wind loading exceed the original design wind loading maximum for that assembly, the Project must replace the foundation, pole, and mast arm assembly.

POLE FOUNDATIONS

- a. The final location of pole foundations shall be approved by the engineer in the field prior to installation.
- b. Pole foundations shall be per WSDOT applicable design standards.

6. ILLUMINATION / ELECTRICAL

- a. New illumination or illumination added to existing systems shall comply with the City's Lighting Design Guidelines (Policy R-40).
- b. Existing illumination systems served by a single power source may need to be split into systems with separate power sources.
- c. Existing or higher illumination levels shall be maintained by using existing or temporary illumination until the new illumination system is operational.
- d. The contractor shall perform an independent utility verification prior to any illumination, vault and conduit installation and inform the engineer immediately if any additional conflicts are found.
- e. The Contractor is responsible for maintaining a minimum 10' clearance zone around existing aerial primary power lines during construction. Coordinate work with the power company. See [WAC 296-155-428](#) for more information.
- f. Luminaire standards and foundations shall be installed according to WSDOT applicable standard plans. Contractor shall verify soil conditions prior to construction.

- g. Illumination splices shall be made with C-TAP (COPPER CRIMP), 3M 2000 MASTIC WATERPROOFING, and 3M SUPER 88 TAPE.
- h. The contractor shall coordinate with the electric utility company regarding the electrical service connection. The contractor shall propose the exact location to the CIP representative and meet with the electrical utility company representative prior to installation of meter base.
- i. Pedestrian and roadway illumination poles shall NOT be located within ten (10) feet of a driveway.

7. SIGNING

- a. Street names on mast arms should follow MUTCD standard. 2009 MUTCD Section 2D.43 calls for street names to have 12" high initial capital letters and 9" high lowercase letters.
- b. All street name signs shall have a city logo.
- c. All signs shall be new. The City does not allow relocations of existing signs to ensure that signs meet current standards for legibility and retro-reflectivity.

8. CABINETS

GENERAL

- a. Cabinets shall be delivered to the City of Kirkland signal shop for testing.
- b. Cabinets shall attach to foundation per manufacturer's specification. Installation shall be done in dry conditions.
- c. Contractor shall place a minimum 1/2" continuous silicon bead between the cabinet and the foundation.

TRAFFIC SIGNAL CABINET LOCATION

- a. Factors to consider when choosing a location:
 - 1) Proximity to power supply.
 - 2) Proximity to fiber connections.
 - 3) View of vehicles approaches from the cabinet location.
 - 4) Door should open to allow technicians to face the intersection when viewing the inside of the cabinet.
 - 5) Sight distance for vehicular movements including right turn on red.
 - 6) Access for maintenance vehicles and equipment/distance to parking.
 - 7) Above likely flood areas.
 - 8) Out of likely path of errant vehicles.
 - 9) Obstructions posed to pedestrians.
 - 10) Distance from high voltage sources.
 - 11) Distance from existing utilities.
 - 12) Traffic signal cabinets shall be located at or above finished grade to prevent water intrusion.
 - 13) Aesthetic considerations.

TRAFFIC SIGNAL CABINET FOUNDATION

- a. See cabinet foundation pre-approved plans [CK-TS.03](#) and [CK-TS.04](#).
- b. Cabinet foundation shall be class 3000 air entrained concrete from a commercially mixed source. Engineer shall approve form work before placement of concrete.
- c. Conduit shall extend 2" above cabinet foundation.

SERVICE CABINETS

- a. See [CK-TS.05A](#) and [CK-TS.05B](#).
- b. A 1" conduit shall be installed under service cabinet for grounding.

ITS CABINETS (FUTURE)

TERMINAL CABINETS

- a. Poles with double mast arms shall have two terminal cabinets.
- b. All new signal based pole mounted terminal cabinet shall be placed on the pole to provide 10' clearance from the bottom of cabinet to the finished grade of walkway.
- c. Locations of terminal cabinets are to be verified prior to cutting holes for mounting.

RRFB CABINETS

- a. See CK-TS.14 for details on mounting RRFB controller cabinets.
- b. See [CK-TS.10](#) and [CK-TS.11](#) for service cabinet details.

9. VEHICLE DETECTION

- a. For approaches with speed limit less than 35 MPH, use video detection with (45') stop bar detection zones.
- b. Video detection zones shall be aimed and adjusted as approved by the engineer.
- c. The location of video detection cameras shall be verified in the field by the engineer prior to installation.
- d. On approaches with speed limit equal or greater than 35 MPH combine video detection at the stop bars (short detection zone) with inductive loops located upstream based on stopping sight (Xs) distance from stop bar. Where:

$$Xs = St + \frac{s^2}{2(d + (32.2 * G))}$$

S=85th Percentile Speed (ft/sec)

t=Perception Reaction Time (1 sec)

d=Deceleration Rate (10 ft/sec²)

G=grade

- e. Check to see dilemma zones are not created and that slower vehicles can clear the intersection. Refer to FHWA *Traffic Detector Handbook-2006* **Detection for Dilemma Zone**, Pages 4-25.

- f. Use inductive loops as system loops to support traffic responsive operation and for individual lane counting. System loops should be placed so that entering turning and entering and exiting through vehicles can be counted separately.
- g. In some cases, small diamond shape loops may be required to count right turning vehicles.
- h. See Standard CK-TS.02 for typical detection layout and numbering system.
- i. Pull a separate lead-in wire for each of the system/counting loops, 2CS per loop, from the nearest J-box to the controller cabinet.
- j. Induction loops shall be spliced and tested by Contractor.
- k. The location of induction loops shall be verified in the field by the engineer prior to installation.

10. CCTV CAMERAS

- a. The location of CCTV cameras shall be verified in the field by the engineer prior to installation.

11. JUNCTION BOXES

- a. WSDOT Type 8 junction boxes (WSDOT Standard Plan J-40.30-04) are usually placed on each quadrant of an intersection. Types 1 and 2 are used in other locations.
- b. Use TA vaults wherever fiber is being pulled.
- c. All junction box and vault covers shall be rated for h20 loading.
- d. All existing junction boxes shall be replaced with new ones when within the ground-disturbing limits of a construction project, or wherever a conduit leading to an existing junction box is replaced.
- e. Existing junction boxes in paved areas should be relocated outside those paved areas.
- f. **New** junction boxes shall **not** be placed in the following locations:
 - 1. Sidewalks ramps
 - 2. Traveled way, unless a utility-style manhole is provided
 - 3. Sidewalks, unless otherwise approved by Transportation Division Staff
 - 4. Paved shoulders
- g. In the event a junction box is located in a pedestrian circulation path, it shall have an approved non-skid coating on the lid. Refer to City of Kirkland Policy G-2.
- h. In the event a junction box is located within a sidewalk, it shall be placed parallel or perpendicular to the sidewalk panel in which it resides.
- i. Use heavy duty junction boxes per WSDOT Standard Specs 9-29.2(2) where maintenance vehicles are likely to drive over them, for example near controller cabinet.
- j. Junction box lids shall be labeled in accordance with WSDOT Standard Spec 9-29.2(4)
- k. Junction boxes, connected by 2" conduit, shall be placed at the limits of each project to allow for future expansion of conduit systems.

- l. The location of junction boxes shall be approved by the engineer in the field prior to installation.
- m. Junction box dimensions shall be sized according to the number and size of conduits sweeping into and out of the box as well as the junction box's specific capacity requirements. Refer to [WSDOT standard plans J-40.10](#) and [J-40.30](#) for specific dimensions and capacity requirements.

12. CONDUIT/CABLE/WIRE

- a. Any existing galvanized conduit shall be replaced with PVC conduit.
- b. Conduits shall be PVC schedule 80 when installed under roadways and high-volume driveways. In all other locations, conduits shall be PVC schedule 40 unless otherwise specified by Transportation Division staff.
- c. All new PVC conduits containing conductors shall have ground wire. Ground wire size shall match the largest conductor (Min #8 or as noted otherwise in wire notes). Spare/empty conduit shall contain electrically detectable pull tape and be marked as "City of Kirkland" conduit.
- d. Verify capacity of any existing conduit considered for re-use by passing a mandrel through them.
- e. Preserve existing PVC conduit and junction boxes, particularly those used for advance loops.
- f. Open cuts shall be backfilled with CDF.
- g. Lighting circuitry, conductors, and fiber optic cable shall each be located in separate conduit and junction box systems.
- h. Fiber optic cable shall be located at least 12" from any other conductor.
- i. Two spare 2" conduits with pull ropes should be placed across all road crossings.
- j. To allow for expansion of signal heads, signs, etc., without construction of a new foundation, one spare 2" conduit shall be installed from each mast arm foundation to the nearest junction box.
- k. Turns or bends in conduits shall occur only at junction boxes. This is to ensure they are locatable in the future.
- l. Conduit shall enter poles only through junction boxes.
- m. The contractor shall install conduit by directional boring unless otherwise specified. No trenching or "blind" drilling shall be permitted.
- n. Conduit may be spliced by glued joints only.
- o. All conduits shall be terminated with a bushing.
- p. Fiber optic cable shall not be coiled in controller cabinet.
- q. The contractor shall perform an independent utility verification prior to conduit installation and inform the engineer immediately if any conflict is found.
- r. The final location of all conduits shall be approved by the engineer prior to installation.

III. MATERIALS (FUTURE)

IV. TRAFFIC SIGNAL GENERAL NOTES

The following traffic signal general notes should be added to construction plans for projects of all types involving traffic signals, roadway/pedestrian illumination, RRFBs, speed radar feedback signs, and school zone flashing beacons. Only relevant notes that apply to specific project types should be shown. Further notes can be added based on engineering judgement.

1. A PRE-CONSTRUCTION CONFERENCE SHALL BE HELD PRIOR TO THE START OF CONSTRUCTION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING ALL NECESSARY PERMITS PRIOR TO CONSTRUCTION.
3. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH WSDOT/APWA STANDARD PLANS, STANDARD SPECIFICATIONS, CITY OF KIRKLAND PRE-APPROVED PLANS, AND THE LATEST AMENDMENTS TO PROJECT MANUAL, SPECIAL PROVISIONS, AND THE APPROVED PLANS.
4. A COPY OF THE APPROVED PLANS MUST BE ON THE JOB SITE WHENEVER CONSTRUCTION IS IN PROGRESS.
5. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE ADEQUATE TRAFFIC CONTROL TO ENSURE TRAFFIC SAFETY DURING CONSTRUCTION ACTIVITIES; THEREFORE, THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN TO THE PUBLIC WORKS DEPARTMENT AT LEAST TWO WEEKS PRIOR TO STARTING ANY WORK IN THE RIGHT OF WAY. ALL TRAFFIC CONTROL DEVICES SHALL CONFORM TO THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) AND THE [CITY OF KIRKLAND'S POLICY R-29](#).
6. ANY EXISTING PUBLIC IMPROVEMENTS DAMAGED DURING CONSTRUCTION SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE PRIOR TO FINAL INSPECTION.
7. THE CONTRACTOR IS RESPONSIBLE FOR KEEPING ALL PUBLIC STREETS FREE OF MUD AND DEBRIS AT ALL TIMES. THE CONTRACTOR SHALL BE PREPARED TO USE POWER SWEEPERS OR OTHER PIECE OF EQUIPMENT NECESSARY TO KEEP THE ROADWAYS CLEAN.
8. EXISTING SIGNAL SYSTEM TO BE OPERATIONAL AND VISIBLE BY THE INTENDED USER UNTIL SWITCH OVER. SEE CONTRACT SPECIAL PROVISIONS FOR SWITCH OVER AND REMOVAL INFORMATION.
9. EXISTING STREET AND PEDESTRIAN LIGHTING TO REMAIN OPERATIONAL UNTIL SWITCH OVER TO NEW SYSTEM. ILLUMINATION SHALL BE MAINTAINED TO EXISTING BETTER LEVELS DURING ALL PHASES OF CONSTRUCTION. A TEMPORARY SYSTEM MAY BE USED TO ACHIEVE THIS GOAL. SEE KIRKLAND'S STREET LIGHTING DESIGN GUIDELINES FOR MORE INFORMATION.

10. ALL SIGNAL SYSTEM COORDINATION WITH KIRKLAND TRAFFIC SHALL BE DONE THROUGH KIRKLAND CIP REPRESENTATIVE.
11. ANY ROADWAY/INTERSECTION SIGN/MARKING REMOVED OR TEMPORARILY MOVED BY THE CONTRACTOR SHALL BE RESTORED BY THE END OF DAY AS TO COMPLY WITH THE CURRENT CITY OF KIRKLAND STANDARDS.
12. ALL SIGNS SHALL BE NEW.
13. WHEN AN EXISTING ROADWAY IS TO BE WIDENED, THE EXISTING PAVEMENT MUST BE SAWCUT AT LEAST ONE FOOT FROM THE EDGE TO PROVIDE A PROPER MATCH BETWEEN NEW AND EXISTING ASPHALT. HOWEVER, WHEN EXISTING PAVEMENT CONTAINS ALLIGATORED AREAS, THOSE AREAS MUST BE REMOVED PRIOR TO WIDENING. ALL SAWCUTS MUST BE PARALLEL OR PERPENDICULAR TO THE RIGHT OF WAY CENTERLINE.
14. BACKFILL IN ALL STREET CUTS ON ARTERIALS WILL BE CONTROL DENSITY FILL (CDF). CONTRACTOR MUST PROVIDE STEEL PLATES TO ALLOW THE CDF TO CURE.
15. WHEN INSTALLING NEW SIDEWALKS, THE AREA BEHIND THE SIDEWALK MUST BE GRADED SO THAT THE YARD DRAINAGE DOES NOT DRAIN OVER THE SIDEWALK.
16. SIDEWALK AND CURB AND GUTTER CANNOT BE POURED MONOLITHICALLY. THERE MUST BE A COLD JOINT OR FULL-DEPTH EXPANSION JOINT BETWEEN THEM.
17. ALL CONCRETE FOR SIDEWALKS AND CURBS AND GUTTERS MUST BE 4000 PSI MINIMUM.

V. INSPECTION/TESTING PROCEDURES

(FUTURE)

VI. PRE-APPROVED PLANS INDEX

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CK-TS.02	Typical Detection Layout and Numbering
CK-TS.03	Controller Cabinet Foundation
CK-TS.04	Signal and Service Cabinet Foundation
CK-TS.05	Service Cabinet
CK-TS.06	Fiber Optic Vault
CK-TS.07	Signal Head Clearance Detail
CK-TS.08	Roadway Lighting Detail
CK-TS.09	Service Cabinet Foundation
CK-TS.10	Tiny Service Cabinet
CK-TS.11	Tiny Service Cabinet Foundation
CK-TS.12	Pedestrian Pushbutton Detail
CK-TS.13	Flashing School Zone Beacon Detail
CK-TS.14	Rectangular Rapid Flashing Beacon (RRFB) Detail
CK-TS.15	Radar Speed Sign Detail
CK-TS.16A	4" Aluminum Pole Bases - Option A
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CK-TS.17	4" Aluminum Pole Base Foundation

VII. PRE-APPROVED POLICIES INDEX

TS-01	Pedestrian Recall Guidelines
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